VOLUME THREE

HINTS & KINKS

for the Radio Amateur

. . . A Symposium of 291 Selected Practical Ideas from the Workshops and Stations of Expert Radio Amateurs

Price 50 cents

Published by the AMERICAN RADIO RELAY LEAGUE • West Hartford, Conn.

VOLUME THREE

Hints & Kinks

for the Radio Amateur

A Symposium of 291 Selected Practical Ideas from the Workshops and Stations of Expert Radio Amateurs.

PUBLISHED BY
THE AMERICAN RADIO RELAY LEAGUE, INC.
WEST HARTFORD 7, CONNECTICUT, U.S.A.
1945

Volume Three of Publication No. 10 of the American Radio Relay League. Copyright 1945 by the American Radio Relay League Inc., West Hartford 7, Connecticut, U.S.A. Printed in U.S.A. First printing, May, 1945.

PRICE 50 CENTS, POSTPAID

Volumes One and Two of this publication are now out of print.

Foreword

THE SUCCESSFUL RADIO AMATEUR is, by nature, an ingenious fellow. Without a high order of resourcefulness and an ability to improvise he could never overcome the ever-present problem of inadequate workshop equipment and the equally common handicaps of insufficient apparatus and money. Evidence of this inherent ingenuity is to be seen on all sides. One cannot visit any good amateur station without finding clever improvisations, either in the construction of individual components or in the manner in which the whole station is assembled. It may be just a different way to mount a coil, or a scheme for getting a broken antenna halyard back upon the mast, or a fabulous remote-control system. Whatever the idea, it is invariably of value to the rest of us.

With the object of putting the best of these "brain storms" into circulation there has appeared in *QST*, these many years, a department devoted to the general subject of "Hints and Kinks." This department has enjoyed great popularity. The ideas contributed to it by ingenious amateurs have helped us all in our search for ways and means to improve our equipment. Unfortunately this garnered gold of amateur experimentation often has been lost to sight, shadowed by some big article or forgotten in the excitement of some major development. Then, too, there has been the annoying business of vaguely remembering a squib bearing on the problem at hand but being unable to locate it when it is most needed.

These factors led us, in May, 1933, to publish a collection of the best ideas, schemes and methods offered by *QST* contributors during the three years prior to that date. The first edition of *Hints and Kinks* was well received and established definitely the value of a single grouping of selected "experimental expedients," carefully classified and indexed. In 1937 a second volume of Hints and Kinks was published, containing a larger and more comprehensive collection of newer ideas culled from the offerings of *QST* contributors in the period 1934–1937. This edition proved even more popular than the first, and has been accorded widespread acceptance up to this time.

Since 1937 amateur technique has been materially refined and much development of newer tubes, circuits and constructional techniques has occurred. This trend, of course, has been faithfully reflected in *QST*. Accordingly, this new volume of *Hints and Kinks* has been assembled to correlate the best of the prewar ideas. Much of the material has appeared in the "Hints and Kinks" department of *QST*. Some of it has been gleaned from larger articles where it was doubtless lost to the view of many. Arranged in its present form, the material should constitute a potent help both in new construction and reconstruction. It should suggest many intriguing possibilities for putting back to work prewar gear apparatus now gathering dust in the attic. Above all, it should enable each of us, in one way or another, in the planning and assembly of our postwar stations.

We express our thanks to those amateurs whose willingness to offer the result of their efforts to the fraternity as a whole has made this publication possible.

VOLUME THREE

Hints & Kinks . . .

1 For the Workshop 7

2 For the Receiver 13

3 For the Transmitter 25

4 For the 'Phone Rig 45

5 For the Power Supply 51

6 For the Antenna System 67

7 For V.H.F. Gear 85

8 For Keying and Monitoring 97

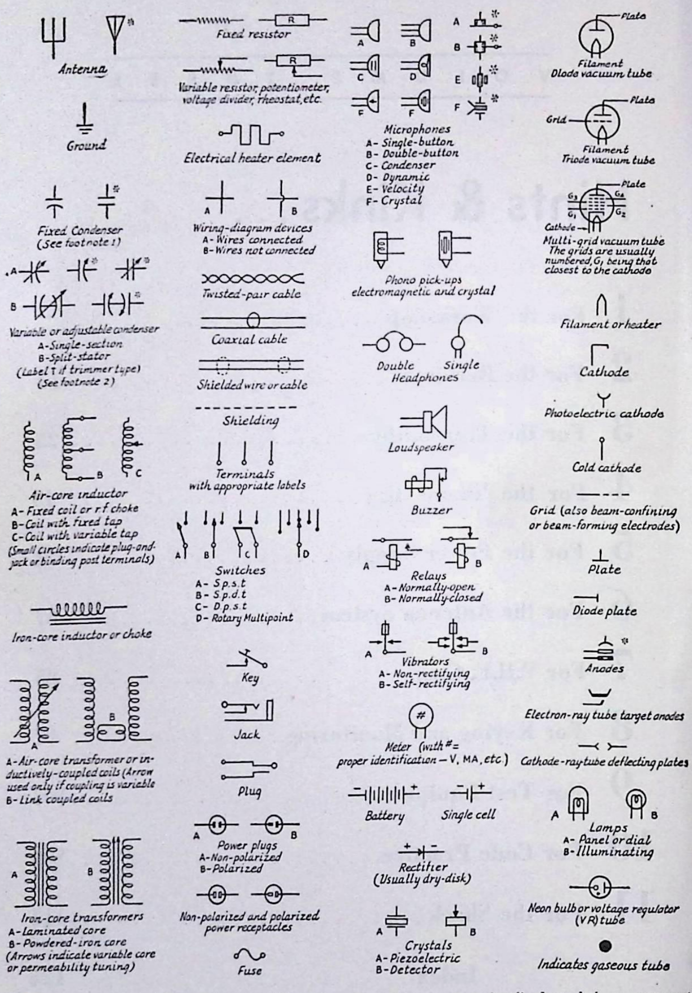
9 For Test Equipment 103

10 For Code Practice 109

11 For the Shack 113

Index 125

STANDARD SCHEMATIC SYMBOLS USED IN CIRCUIT DIAGRAMS



For convenience and simplicity, schematic wiring diagrams employing conventionalized symbols to represent various components, as shown above, are utilized to indicate the circuit connections used in radio apparatus. The symbols used in this *Handbook* follow the new standardized forms adopted by the radio industry under the ASA standardization program in 1944.

[*] Alternative symbols marked with an asterisk are the conventional radio forms used prior to mid-1944. These are included for reference information in instances where the original symbol has undergone appreciable change.

[1] Where it is necessary or desirable to identify the electrodes, the curved element represents the *outside* electrode (marked "outside foil," "ground," etc.) in fixed paper- and ceramic-dielectric condensers, and the *negative* electrode in electrolytic condensers.

[2] In the new symbol, the curved line indicates the moving element (rotor plates) in variable and adjustable air- or mica-dielectric condensers. To distinguish trimmers, the letter "T" should appear adjacent to the symbol.

In the case of switches, jacks, relays, etc., only the basic combinations are shown. Any combination of these symbols may be assembled as required, following the elementary forms shown.

1. *Hints and Kinks . . .* for the Workshop

SOLDERING-IRON REST AND HEAT CONTROL

FIG. 101 shows a soldering iron heat control that I have been using for the past ten years.

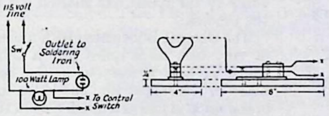


Fig. 101 — Soldering-iron rest and heat control.

In the original I used an old closed-circuit 'phone jack which, with all other components, was mounted on a 4 × 12 × ¼-inch piece of plywood. The rest for the iron is of sufficient size to dissipate heat rapidly enough to prevent burning of the contacts by conduction. The size of the bulb may be varied to obtain just the right degree of heat with the iron in use.

The leaves and contacts of the jack will have to be altered to correspond with the arrangement shown in Fig. 101. The tension of the lower spring contact should be adjusted so the weight of the iron on the rest just opens the points, putting the lamp in series with the iron and keeping it just hot enough to use but not hot enough to burn and pit. — *Harold F. Houtz.*

* * *

SOLDER KINK

A HANDY arrangement for wire solder can be made by winding the solder around a pencil for its entire length, starting at the point of the pencil. After removing the pencil, the end of the solder is passed back through the coil and out through the opening in the pointed end. The coil is then used as a handle. As solder is used, more may be pulled out. Solder in this form does not kink and is in convenient shape for getting into tight places. The roll is shown in Fig. 102.

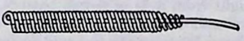


Fig. 102 — Convenient form for solder roll.

SOLDERING-IRON PROTECTIVE WARNING

NO DOUBT many members of the fraternity have at one time or another left their soldering irons with the current on and discovered the fact only after many hours. Even when one has rigged up a nice separate outlet and switch equipped with a pilot light he is likely to use the soldering iron at some other outlet or location and then forget all about it, only to find it hot a day or two later.

Here is a practicable method of avoiding such oversights which both my son, W9INN, and I have used with full success. First, we bought a plug-in multiple outlet which can be plugged into any wall socket. This one has a screw-socket opening into which one of the very small dime-store red bulbs can be screwed. Next, the soldering-iron plug also was plugged into this same outlet, as shown in Fig. 103. Now we have a red light bulb at the plug end of the soldering-iron cord. This plug-in socket and bulb are never separated from the soldering-iron cord. When the iron is disconnected the whole assembly, plug-in socket and all, is just pulled out of the wall socket, and when the iron is used again the whole thing is simply plugged into the wall socket. Thus, no matter where the soldering iron may be used, the red light always shows when the current is on. If an outlet of the type described cannot be found there also is available in many dime stores a candelabra socket for Christmas-tree size bulbs, fitted with a two-prong base which may be plugged into a standard three-way plug-in outlet. — *H. A. Fanckboner, W9BPS.*

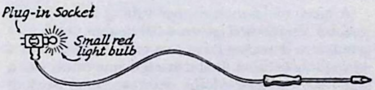


Fig. 103 — Warning light for soldering iron.

* * *

IMPROVISED SOLDERING TORCH

IF A BLOWTORCH or spirit lamp is not available for a heavy soldering job, an excellent Bunsen burner can be improvised for use on the kitchen gas range. An empty vegetable can, of a size which will make a snug fit, is inverted over a gas burner. A small hole is punched in the end of the can, the gas turned on, and a match applied at the hole. A pencil point of hot blue flame will result which will heat and make ready for the solder in jig time any job that can be moved to the burner. — *Frank Keefe, W1MTP.*

—...—

A HOMEMADE GAS SOLDERING TORCH CONSTRUCTED FROM SCRAP COPPER TUBING

A HOMEMADE gas soldering torch which I have been using for a number of years is shown in Fig. 104. Such a torch is useful for jobs which are too large to be heated with an ordinary soldering iron. The torch may be made in any size. All of the required materials may be obtained readily and probably can be found by most hams in the junk box or a junk yard.

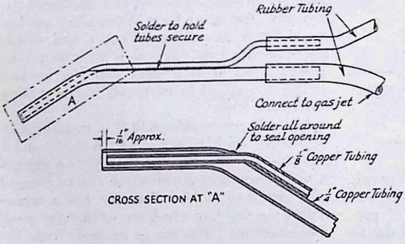


Fig. 104 — **Constructional details of the homemade gas soldering torch.**

A piece of ¼-inch copper tubing is cut to the desired length and given a 30-degree bend at a point 3 or 4 inches from one end. At the bend a ⅛-inch hole is drilled through one wall, on a line with the axis of the short section. Next, a piece of ⅛-inch copper tubing is inserted through the drilled hole to a point approximately 1/16 inch inside the end of the short section of the ¼-inch tubing. The external length of the ⅛-inch tubing is bent down to lie along the longer or shank section of the ¼-inch tubing. It then is soldered in place all along the adjoining length of the ¼-inch tube from a point an inch or so from the open ends of the shank sections. The joint at the drilled hole is also soldered, in order to make an airtight connection.

A length of automobile windshield wiper rubber tubing is slipped over the open shank end of the ⅛-inch copper tube, and a piece of rubber gas tubing is attached to the shank end of the ¼-inch copper tube.

The large tube is connected to a gas jet and the flame lighted at the mouth of the torch. The open end of the small rubber tube is placed in the mouth, and the breath is blown through it. The result is a cone-shaped flame of intense heat.

By increasing the gas flame to a length of 18 inches or so and delivering air from a compressor at 25 or 50 pounds pressure through the small tube, enough heat can be obtained to melt aluminum. By this means I have made successful aluminum castings in plaster forms, using the homemade torch. — *J. Hengel, Route 10, North Kansas City 16, Mo.*

—...—

SIX-VOLT SOLDERING IRONS

EVER wish you had a soldering iron in the car? A. D. Hewett of Powell River, B. C., tells how he made a 6-volt soldering iron which can be used on either a.c. or d.c.

The tip was made of a piece of ⅜-inch copper rod about 3 inches in length, one end of which was bored to a depth of 2¼ inches with a ¼-inch drill.

The heating element is a 12-inch length of No. 25 Nichrome wire wound in a spiral to an outside diameter of 3/16 inch. The upper end of the spiral was led back through the coil and brazed to a piece of No. 12 copper wire about 10 inches long. Care was taken to see that none of the turns in the spiral was shorted out in the process.

The element is insulated with a piece of very thin mica rolled into a tube, which in turn is inserted in the hole bored in the copper tip. The lower end of the spiral is laid in a notch filed in the outer opening of the tip bore. This notch was made deep enough to pass the shank, which was forced into the bore after all other parts were in place.

The shank is a 9-inch length of ¼-inch steel tubing. The copper wire from the heating element was insulated with asbestos and led through the shank, which was then forced into the tip bore for about ¼ inch and brazed there, together with the ground lead (lower end) of the heating element. Silver solder was used for the brazing, with borax for a flux.

A handle was made from a section of broomstick drilled to accept the shank. Ends of a 6-foot length of No. 14 lamp cord were passed through the handle and soldered to the shank and the lead from the heating element. The shank then was forced into the handle. Battery clips were attached to the cord.

—...—

A simpler device, limited to very light work, is described by J. R. LaCroix, Brockhurst, Templewood Lane, Farnham Common, Buckinghamshire, England. In this device a metallic mechanical lead pencil is used as one electrode, the lead being extended to project about 3/16 inch. The work itself forms the other electrode. Wire leads are brought from a 4- or 6-volt battery, one to the pencil and the other to the work. The circuit is closed by touching the spot to be heated with the pencil, at the same time applying rosin-cored wire solder.

The pencil lead will become red hot in a very few seconds. Care should be taken to avoid forming an arc at the contact since soldering, not welding, is the object.

SOLDERING-IRON REST TO DISSIPATE HIGHER TEMPERATURES

Higher temperatures are required to melt wartime solder because of the reduced proportion of tin. This means the use of a hotter iron. If the soldering iron is not protected by a thermostat, some means should be provided to dissipate the additional heat when the iron is at rest. A solid block of steel or cast iron may be used to good advantage as a rest for the soldering iron. The block should be sufficiently large to dissipate enough heat to prevent burning of the tip when the iron is not in use. A piece of asbestos should be placed under the rest.

—···—

SOLDERING TIP FOR TIGHT PLACES

It's sometimes a bit hard to get the tip of a soldering iron into an overly crowded spot without unsoldering another spot by accident while trying to solder in the connection. I had an old tip for the iron, too badly worn to be much good, so I cut it off at just the right length to fit the iron barrel. Then I drilled a hole in it about an inch deep lengthwise. The hole should be just large enough to provide a tight fit when a piece of No. 8 or No. 10 copper wire is jammed into it. The end of the wire was flattened just a bit, and presto — we have a soldering iron tip which may be bent around corners or worked into the most congested spots without any trouble. See Fig. 105.

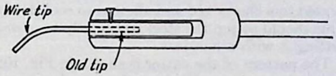


Fig. 105 — Small soldering-iron tip for tight places.

With either No. 8 or No. 10 wire the length of the piece is determined by how much can be used and still obtain sufficient heat at the end to be of any value. For most jobs it needs to be about 1½ inches long. — *Dayton Warner, W9IBC.*

—···—

SIMPLE MAGNETIC HOLDER FOR FERROUS NUTS AND LOCK WASHERS

J. R. Steen of Harvey-Wells Communications contributes the following suggestion which has been found useful in speeding up manufacturing production.

It is an old wrinkle to magnetize a screwdriver (and, in fact, there are many on the market so prepared), but a method of holding nuts and their closest companions, lock washers, has been quite neglected.

Here is a very handy method of assembling steel nuts and lock washers in hard-to-get-at places. Take your ordinary socket wrench or Spintite, wind about a dozen turns of insulated wire around it, and touch the ends of the wire across the storage battery. A single touch is enough to magnetize the wrench sufficiently so it will hold both the nut and lock washer.

CUTTING SQUARE HOLES

Fig. 106-A shows how a lot of filing can be avoided in cutting a square hole in a chassis.

The usual practice is to drill half-inch holes at opposite corners of the rectangle to be cut out and start sawing with the hacksaw immediately. This results in a long sweeping cut from the center of the hole before the saw can be brought along the line marking the side of the rectangle. If time is taken to do a little filing around the holes before the hacksaw is started, the saw can be started in the line and the sides will then require only smoothing up with the file.

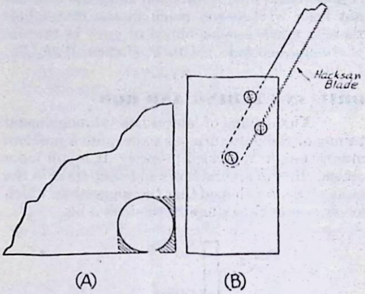


Fig. 106 — Showing how W8EOY avoids a lot of filing in cutting rectangular holes in a chassis.

Fig. 106-B shows how a simple holder for a hacksaw blade may be made in case the regular frame cannot be used. — *Harold S. Davis, W8EOY.*

—···—

DRILLING HINTS

In preparing a metal chassis for drilling it has been suggested that a piece of wrapping paper be fastened about the chassis with adhesive tape. A better method, I have found, is to use a piece of very heavy brown paper cut about a half inch shorter than the length of the chassis. It should be flooded with a rather watery paste (flour and water will do) and then placed in position on the chassis. By smoothing with both hands from the center outward, all air bubbles and lumps can be removed and it will be found that the water has expanded the paper so that it extends to the edges of the chassis.

When dry, the paper will be perfectly smooth due to the tightening effect, even though a wrinkled sheet was used. To remove the paper after the work is finished, simply get permission from the XYL to soak the chassis in the bathtub for a half hour and the paper will drop off.

An added advantage of this method is that it becomes unnecessary to center punch to prevent the drill from walking. The drill will penetrate the paper instantly, of course, and the paper provides a "socket" for the drill.

When drilling socket holes of an inch or more in diameter with a fly-cutter, it is much more satisfactory to cut a little way in from both sides (the deeper you go the more metal in proportion to depth must be removed), and then strike it several times from both sides with a *flat*-headed hammer. In this way the time consumed in cutting is reduced by about three fourths and in addition there are no burrs to be removed later. A good clean hole results and since the drill has not been worked too much in the center hole there is much less likelihood of error in the size of the finished hole. — *W. T. Hodson, W2FJE.*

* * *

DRILLING TUBING AND ROD

The drilling of lateral holes through metal tubing or rod may turn out to be quite a problem unless the job is tackled properly. It is still more difficult to drill several holes and keep them in the same plane. It is hoped that the suggestions which follow will help to simplify the task a bit.

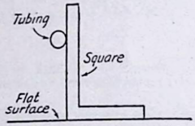


Fig. 107 — Marking a line for spotting holes to be drilled in tubing or rod.

The tubing first should be clamped horizontally in a vise, or be supported firmly by other means, over a flat surface. A square then is placed with one side resting on the flat surface and the other pressed against the side of the rod or tubing as shown in Fig. 107. With the square held firmly against both surfaces, the wall of the tubing is scratched as the square is drawn along its length. The scratch will be perfectly aligned even though the flat base is not parallel with the tubing or tilted at any angle in respect to it. The only important point is that the base must be flat.

The points at which holes are to be drilled are then marked with a center punch along this line. The punch marks should be made rather deep so that the side of the tubing may be flattened very slightly with a file without obliterating them. This flattening will prevent creeping of the drill when the holes are started.

The first hole must be drilled carefully by eye. When it is finished, a machine screw or a piece of wire which fits the hole is inserted. This will provide a "sight" by which the remainder of the holes may be lined up while they are being drilled. — *Vernon Chambers, W1JEQ.*

* * *

TEMPLATES FOR METER AND SOCKET HOLES

A handy template for setting up a circle cutter is suggested by W1JEQ. Each time a hole is cut in Presdwood or metal for mounting a large-diameter part, such as a socket, meter, or transformer, the circle removed from the material should be labeled and filed for future reference. A collection of metal and composition circles thus is soon obtained, from which one corresponding to the part to be mounted may be selected. In order to adjust the radius of the circle cutter the circle is then slipped on the drill point of the cutter, and the tool is fitted to the edge of the circle and set. In this way the time usually spent in setting up temporarily and cutting trial holes is saved.

* * *

REPUNCHING SOCKET HOLES WITH ACCURACY

We often find it necessary, after having selected a punch and knocked out a hole in a chassis, to make this hole larger so as to accommodate an electrolytic condenser or tube socket of larger dimensions. An easy, quick and accurate way of accomplishing this feat is to keep on hand a knock-out from each of your various punches. Then, say you punch a three-quarter-inch hole and find a larger hole necessary. All you need do is re-fit the three-quarter-inch knock-out, place the larger punch in the starting hole and punch away.

This method is particularly successful with screw-type punches, such as the Greenlee. Try it on a piece of scrap and see for yourself how simple it is. — *Thomas B. Moseley, Fort Worth, Texas.*

* * *

HOMEMADE CIRCLE CUTTER

Circle cutters for cutting holes up to 2 inches in diameter may be made quite readily from discarded flat files. The file first should be heated to a cherry red and allowed to cool slowly. This should soften the steel sufficiently to permit cutting it with a hacksaw.

The pattern of the cutter is shown in Fig. 108. Exact dimensions will depend upon the diameter of the hole desired. The end opposite the cutting end is shaped so that it may be clamped in the chuck of a carpenter's brace. The centering spindle, *S*, should be filed down to fit accurately a hole made by a drill of standard size, say ¼-inch. It does not necessarily have to be round, however, so long as it will turn in the centering hole without undue play. The cutting edge, *C*, may be filed roughly to shape before hardening.

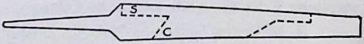


Fig. 108 — A hole cutter made from an old flat file. After it has been heated the steel may be cut readily with a hacksaw.

The hardening process consists merely of again heating the steel to a cherry-red color and immediately dousing it in water. I found that oil tempering made the steel too hard. It is advisable to temper only the cutting end back for a distance of an inch or so, since this prevents snapping off of the cutter up near the end held in the chuck.

After hardening, the cutting edge may be ground for proper cutting qualities. It is, of course, necessary to drill a hole to fit the cutter spindle at the center of the circle to be cut out. — *Robert B. Saylers, W8TUC.*

STARTING TOOL FOR DRILLS

READING an article about polystyrene insulation, in which it is stated that a heavy blow with a center punch may cause a star fracture, prompts me to suggest the use of a tool which I have found extremely useful for starting holes in the construction of radio apparatus. The tool is easily made from a small triangular file, as shown in Fig. 109.

The file is ground similar to one half of an ordinary drill bit, but comes to a point in place of the web and has no twist. It is used in an ordinary hand drill. It cuts quickly and will not slip or run. Drills have no tendency to slip or run when the hole is started with this tool; it is not necessary to use a center punch. — *Gordon Crayford, Lacombe, Alta.*

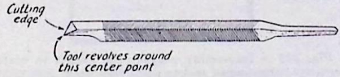


Fig. 109 — Tool for starting drills in metal or other materials.

—···—

DRILLING GLASS, PORCELAIN AND PYREX

THE perennial problem of drilling holes in glass has many solutions. We present here one used successfully by H. W. Loney, ex-9DHO, and J. P. Gilliam, W9SVH. The special tool depicted in Fig. 110 is important in the process.

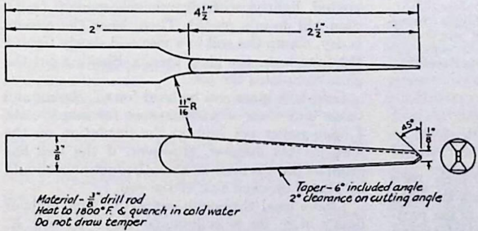

4½"
2"
2½"
11/16" R
3/8"
45°
1/8"
Taper - 6° included angle
2° clearance on cutting angle
Material - 3/8" drill rod
Heat to 1800° F. & quench in cold water
Do not draw temper

Fig. 110 — Drill for cutting glass.

The drawing gives all the necessary details for its construction. For the actual drilling, the authors write:

"Place the drill in a hand brace, engine lathe or slow-speed drill press. If the material to be drilled is flat, such as plate glass, make sure that the supporting surface is flat. Apply turpentine to the point of the drill and press firmly against the work in the desired location. Then turn the drill slowly and apply sufficient turpentine to keep the drill wet at all times. Use care when breaking the point through the work so as to avoid chipping. After the point has broken through, turn the work over and drill from the opposite side, repeating this operation as often as is necessary to keep the edges of the hole nearly parallel.

"This has been the most successful method of drilling these materials that we have been able to find. It is quite possible and practical to drill narrow strips of glass where the holes are close to the edge. Repeated tests have proved that when using a hand brace it is possible to drill ¼-inch diameter holes through 7/32-inch plate glass in 35 seconds.

"Pyrex is somewhat tougher than ordinary glass and will cut considerably slower. Four Pyrex custard cups were drilled in approximately four minutes. Ordinary porcelain such as is used for antenna insulators may be drilled with the same speed as plate glass."

—···—

A KINK FOR THE WORKBENCH

HOW many times have you wished for a third hand when you're trying to solder some small object? The sketch of Fig. 111 shows one simple way of providing that third hand. Take a six-foot strip of one-inch by one-quarter-inch strip or a long lath and fasten it to the front edge of the workbench as shown. The strip should be spaced out from the bench about one-quarter inch at each end with spacing blocks of wood.

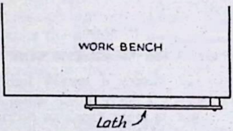


Fig. 111 — Convenient "third hand" for work bench for holding small objects suggested by W2LRT.

Now, when we have some small object we wish to be held, we can wedge it in between the lath and the edge of the bench. The center of the strip can be bowed out somewhat and the object can be slid toward one end until it is held firmly in place. — *Lewis C. Bohn, W2LRT.*

—···—

SOLDERING VISE FOR SMALL PARTS

A SPRING-TYPE wooden clothespin makes a handy vise for soldering small work. Mount it in a vertical position on the workbench. — *W2OEN.*

—···—

USING A FLIT GUN AS A PAINT SPRAYER

AN ORDINARY insect spray gun does an excellent job of spraying smooth or wrinkle-type finishes on chassis, racks, panels and other amateur gear. Such a sprayer has even been used to paint an automobile fender, although the covering of such large surfaces involves the application of a generous amount of elbow grease.

It is recommended that the paint sprayer be used only for painting; another spray gun should be used for flies. — *Robert Lewis, W8MQU.*

CONVERTING SHIM BRASS TO SPRING BRASS

While experimenting with the construction of parts for a transceiver, I discovered a handy kink. "Shim" brass, although normally too soft for use in leaf-type switches or as a vibrator reed, can be work-hardened into a passable substitute for spring brass. A strip of the shim brass is cut to a width about ⅛-inch greater than that required for the finished part. A piece of ¼-inch rod is gripped firmly in a vise. Both ends of the brass strip are grasped firmly by pliers and the strip is drawn back and forth over the rod. About 18 "cycles" are applied to each side of the strip in this manner. Then ⅟₁₆-inch is clipped off each edge of the strip. This gets rid of the little cracks which appear during the drawing process. If not removed, these would lead to failure of the piece if used as a vibrator reed. Shim brass of 0.01-inch thickness is relatively plentiful. Spring brass? Unh-unh! — *Gurdon R. Abell, jr., W2IXK.*

—…—

LIGHT FOR THE WORKBENCH

Fig. 112 shows a handy light for the workbench which I have been using for some time. The shade is made from an ordinary two-pound coffee can. A hole is cut in the bottom of the can to fit a brass-shell pendant receptacle to which the can is soldered.

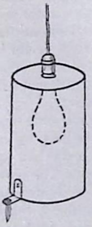


Fig. 112 — W9IBC's homemade lamp for the workbench. The reflector is a 2-lb. coffee can soldered to a brass-shell socket.

The light hangs by the cord which runs through an eyelet in the ceiling so that the light may be raised or lowered to the needs of the project at hand. The banana plug, fastened to the edge of the can with a small angle bracket, fits into a jack which is mounted with a similar bracket on the top shelf above the bench. This holds the light in a position high enough to provide good light for the entire bench. The beauty of the thing is that it can be lowered to provide a spotlight effect when working inside a transmitter or receiver chassis. — *Dayton Warner, W9IBC.*

—…—

SOLDERING CONNECTIONS TO POLYSTYRENE SOCKETS

The low melting point of polystyrene often makes it difficult to make or remove soldered connections to sockets made of this material without damaging the socket. L. T. Fleming, W3HQP, suggests a scheme which will keep the socket cool while soldering the terminals. The idea is shown in Fig. 113. An old coffee can is filled with water. A small "C" clamp, obtainable at any dime store, is used to clamp the socket to the side of the can in such a position that the polystyrene is covered with water while the prongs project above the surface. Old solder then may be safely removed or, if new connections are to be made, long leads may be soldered to each prong and then cut to the appropriate length after the socket has been mounted. Polystyrene coil forms wound with enameled wire may be treated in a similar manner.

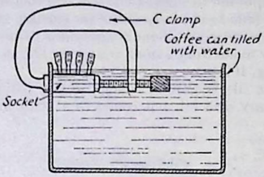


Fig. 113 — Immersing polystyrene socket in water prevents softening of socket while soldering.

—…—

WINDING SMALL SELF-SUPPORTING COILS

After playing around with h.f. receivers and transmitters for some years, I have found that the easiest, simplest and most-efficient method of constructing chokes and coils is to wind them on a thin glass tubing. The outside should be coated lightly with Amphenol cement (collodion will do in a pinch). Then, when the cement is dry, clamp the coil in a vise and slowly tighten the jaws until the glass breaks. Shaking out the glass completes the job.

Grid-leak glass can be used for r.f. chokes and tubes and vials of various sizes for larger coils. I have never yet injured the insulation on the wire in this manner. However, if the vise has grooved jaws, a piece of smooth aluminum should be placed on each side of the coil.

I have used this same method to wind coils of heavy wire on a cellophane core. — *Percy E. Buchtel, W8JTI.*

—…—

HINTS ON WINDING COILS ON SMALL POLYSTYRENE FORMS

In winding a coil of large wire on a small-diameter polystyrene or bakelite form, the process can be simplified by first winding the coil on a smaller-diameter form with a few more turns than is necessary. The coil is then removed from the small-diameter form and worked onto the larger form. Once it is properly in place it can be doped on the form, and the result is a firm coil which will not be as subject to change as one that is wound only for the finished diameter. This method also has the advantage that no holes in the coil form are necessary for fastening ends of wire. — *Jack Hill, W9ZWW.*

2. *Hints and Kinks . . .* for the Receiver

SERIES NOISE LIMITER WITH PLATE DETECTORS

You may be interested in publishing a revised circuit (Fig. 201) for the series diode noise limiter previously described in *QST*. The limiter, installed in an NC-100 receiver, has done an excellent job here at W2GQM, located just a few feet from one of the main arteries of traffic in northern New Jersey. Before the receiver was equipped with the limiter 28-Mc. reception was impossible and even 3.5-Mc. reception was difficult at times. Now, even the weakest signals on 28 Mc. may be copied practically 100 per cent. In fact, it seems that the weaker the signal the better the limiter works!

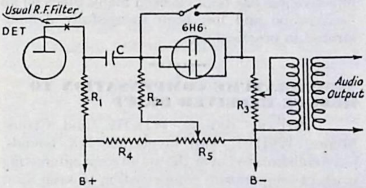


Fig. 201 — Circuit of the series noise limiter as used with a plate detector.

C — 0.1-μfd. paper.
R_1 — 0.1 megohm, ½-watt
R_2 — 0.3 megohm, ½-watt.
R_3, R_4, R_5 — 50,000 ohms.

The original circuit was tried without much success. The difficulty lay chiefly with the infinite impedance detector with which we attempted to replace the plate detector in the NC-100. Because the audio output from the infinite impedance detector was so low, the plate detector had to be reinstalled. Also, it was found that the diode used in our case, a 6H6 with cathodes paralleled and plates paralleled, required a much greater range of voltage than was provided for in the original circuit.

There is no sharp threshold position for the potentiometer. The best position for operation seems to be at the point where, for each individual station, the distortion introduced by the limiter is not too objectionable. If the limiting action is increased beyond this point there will be little improvement in noise reduction and a considerable impairment of audio quality will result. If the limiting action is carried in the other direction audio distortion will not be noticeable, but the signal-to-noise ratio will be lowered. The individual operator will find the position most suitable for him after a bit of experience. Because of the sharp cut-off action of the limiter, high-frequency distortion of both the signal and noise is present to a certain extent in the audio output when the limiting action takes place. If the tone control of the receiver is operated to reduce the high-frequency response, this effect will not be noticed. As was mentioned in the original article, when a strong beat oscillator signal is present the incoming noise will modulate it, and the limiter will have a harder job to do. In this case the limiting action can be advanced beyond a point which would be objectionable for 'phone work because the resultant distortion can be tolerated in c.w. reception.

Although the circuit as shown was designed for an NC-100 receiver, the same circuit may be applied to any transformer-coupled detector. The 100,000-ohm resistor in the plate circuit may be replaced by an audio choke of 250 henrys or more, but it was not deemed necessary because the d.c. drop through the resistor to the plate is negligible in most detectors. The switch shown across cathode and plate is provided so that the operator may disconnect the limiter without disturbing the setting of the potentiometer, although the same result may be achieved by setting the potentiometer to the extreme position away from limiting action. Contrary to what might be expected, there is no noticeable reduction in the audio volume of the receiver when the limiter is in normal use — although, of course, the extreme setting of the potentiometer will limit everything — and completely!

The limiter is most effective on auto ignition and least effective on vacuum cleaners and electric razors, although even on these latter it may mean the difference between reading and not reading a signal. — *Paul Rafford, Jr., W2GQM.*

* * *

SIMPLE NOISE-LIMITER ADDITION TO RECEIVER

Although much has been done to simplify noise silencers and reducers, there still are many who consider these devices too complicated or costly to be added to their receivers. Because of this fact much operating enjoyment on the high-frequency bands is sacrificed in regions of strong noise interference.

The circuit of a single-diode noise limiter is well known and extensively used with single- and parallel-diode second detectors. For receivers using full-wave diode detection, the two separate diodes of a 6H6 tube may be used in an equally simple circuit adapted from the one mentioned above. Typical circuit diagrams of the former type of noise limiter are shown at (B) and (C) of Fig. 202, while a diagram for use with a full-wave detector is shown at (D). In any case, the total list of parts to be added to the receiver (assuming that a suitable source of negative bias voltage is available) includes only a 6H6 tube and socket, a by-pass condenser, and a small potentiometer resistor.

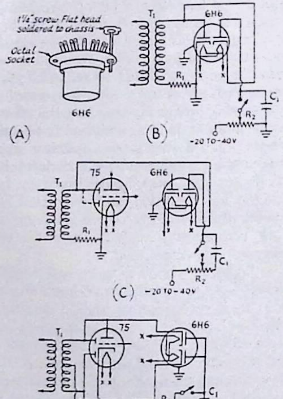


Fig. 202 — Simple receiver circuit changes required to incorporate a noise silencer. The 6H6 is mounted in an inverted position beneath the chassis by means of a single flat-head screw.

R_1 — Diode-detector load resistor in receiver.
R_2 — 25,000-ohm potentiometer.
C_1 — 0.1-μfd. paper.

Since the 6H6 tube and socket are light and compact, the assembly may be mounted beneath the chassis by means of a single long screw soldered in place. Alternatively, a longer screw may be substituted for one of the short screws or rivets holding a tube socket in place, and the lower extension may thus be used.

The 0.1-μfd. condenser should be mounted near the 6H6 socket. Many sets are equipped with fixed bias supply; in these, the negative voltage applied to the suppression-control potentiometer may be set to a desirable value at the voltage-divider resistor. This should not noticeably affect the other voltages taken from the divider, since the current through the control is only one milliampere, approximately. The potentiometer should be equipped with a switch and connected so that beginning rotation in a clockwise direction places the noise limiter in action, while further rotation increases the noise suppression.

Addition of the 6H6 tube to the circuit of the second detector may detune this circuit slightly. In order to check on this point, the 6H6 should be taken from its socket while a steady signal is being received, to determine whether a noticeable increase in output accompanies the removal. If a change is noticed, realignment of the i.f. transformer tuning condensers with the tube in operation should follow. It is important that the 6H6 tube be one in good condition; it might otherwise prove, because of leakage, to be a noise contributor rather than a noise limiter.

On very strong signals the noise limiter tube may cause noticeable audio distortion, although a limiter is seldom needed on signals of this sort. If such distortion is objectionable, however, a higher value of negative voltage may be applied to resistor R_2.

The cost of the suppressor is low and it can be used without seriously altering the receiver. The effectiveness has been checked many times on an oscilloscope and has been successfully demonstrated in practical use.

* * *

TEMPERATURE COMPENSATION TO REDUCE RECEIVER DRIFT

Stuart Briggs, W1KHE, and Claude Moore, W9HLF, two inveterate DX hounds, have collaborated over the air on some interesting work in temperature compensation to keep their receiver calibrations on the nose, come rain or shine. While the work of both has been with the National 101X, the same principles applied to other receivers should form a basis for similar temperature compensation.

Without compensation, the drift would vary from 20 to 45 dial divisions, depending upon the temperature of the room when the receiver was turned on. All tests were made with the receiver "B" supply turned on one minute after the voltage was applied to the heaters.

They started out the tests by connecting a Centralab 10-μμfd. negative-coefficient condenser (type 913N) from ground to the grid leak of the high-frequency oscillator, placing the condenser very close to the top of the 6J7. To compensate for the added capacity, the capacity of the air trimmer in the h.f.o. coil compartment was reduced correspondingly. Using a temperature-controlled oscillator for checking the drift, it was found that the receivers ran off calibration by two or three dial divisions at the beginning of a cold start. Within 5 to 8 minutes, the calibration would return to the original position and remain there within a dial division or so over periods of several hours.

Next, the mixer and r.f. circuits were given the same treatment. The improvement in stability was immediately evident. The compensating action was speeded up, and, from a cold start, the calibration would deviate only about 15 dial divisions and return on the nose within three minutes. The more accurate maintenance of circuit alignment resulted in a noticeable improvement in the gain of the receiver.

More recently W9HLF replaced the metal tubes in the h.f. circuits with a set of three of the Hytron GTX series. Some slight changes were necessary to suspend the compensating condensers over the glass tubes, which are taller than the metal envelopes. This change resulted in an improvement in receiver sensitivity. W1KHE, following suit, experienced a similar improvement. With the new tubes it became necessary to readjust the compensation. By reducing the compensating capacity in each case from 10 $\mu\mu$fd. to 5 $\mu\mu$fd., the compensation was brought back into line. Since condensers with capacities of less than 10 $\mu\mu$fd. were unavailable, two 10-$\mu\mu$fd. units were connected in series.

By this time both operators had become supercritical in the matter of frequency drift. In observations over long periods of operation they noticed a slow drift upward in frequency which occurred after a run of ten to twelve hours. Although the drift was at the rate of only a dial division per hour, they decided to eliminate it, if possible. After a lengthy investigation it was determined that this secondary drift was caused by a lagging rise in temperature in the coil chamber. To compensate for this a negative coefficient condenser of approximately 7 $\mu\mu$fd. (25 $\mu\mu$fd. and 10 $\mu\mu$fd. in series) was connected directly across the air trimmer in the coil compartment with the condenser mounted right against the coil with the aid of a drop of Duco cement. This completed the job.

W9HLF says that he has run his receiver for as long as four and five days at a stretch without having the calibration vary more than one dial division. During 24 hours the temperature might have varied from 40 to 100 degrees. "I've become so used to being able to spot a certain signal day in and day out at the same zero-beat point on the dial and, after five minutes of warm-up, always finding my 100-kc. frequency-meter signal spotted at the same old dial division of the 101X that I take it all for granted now. Only when I get hold of some other fellow's receiver do I notice how unstable the best of them may be."

While most of this work has been done at 14 Mc., W1KHE has had similar success at the lower frequencies.

* * *

SOME HETROFIL SNAGS AND THEIR SOLUTION

No doubt many have constructed the Hetrofil described in the September, 1939, issue of *QST*. The original circuit is shown in Fig. 203-A. If the writer's experience is anything to go by, some will have found results not quite as satisfactory as they had hoped. Perhaps these few notes will assist those who have found snags.

In the first place, the Hetrofil will virtually eliminate any single audio frequency if properly constructed, but it cannot be expected to deal with an unsteady note or one that is heavily modulated. Given a really steady unmodulated frequency, it can and will eliminate it.

Those who have found that a balance cannot be obtained will be interested to know that the most likely cause of the trouble is in the ganged resistors, R_2 and R_3; in fact, if one considers the matter for a moment, it would be rather surprising if these items were to track accurately. In practice they seldom do. Even supposing one obtained a satisfactory pair, there would still be a slight variation in the capacities of the condensers to be reckoned with. By the addition of one further component, the difficulty is overcome. This consists of a potentiometer of 1000 ohms, R_7 in Fig. 203-B, connected in such a manner that, when moved in either direction from its central position, it adds resistance in one leg and at the same time subtracts it from the other. A little thought will show that any failure to track correctly on the part of the ganged potentiometers is thereby compensated.

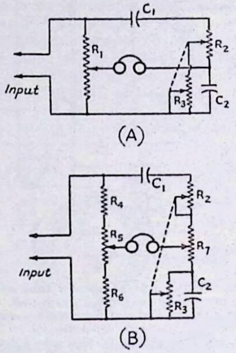


Fig. 203 — Suggestion for improving the performance of the Hetrofil. The original circuit is shown at (A). The addition of the resistance, R_7, in (B) permits compensation for differences in characteristics of the ganged resistors, R_2 and R_3, and the fixed condensers, C_1 and C_2.

C_1, C_2 — 0.05-μfd. paper.
R_1 — 5000-ohm potentiometer.
R_2, R_3 — Ganged 10,000-ohm potentiometers.
R_4, R_6 — 2000 ohms, ½-watt.
R_5, R_7 — 1000-ohm potentiometer.

* * *

ANOTHER USE FOR THE MAGIC EYE

The resistance-coupled push-pull and phase-inverting types of audio amplifier are essentially made up of the same parts and are open to the same troublesome objection. In the absence of frequent testing, there is no assurance that good symmetry exists; and, without it, maximum power and minimum distortion cannot be realized. The 6E5 electron-ray indicator provides an inexpensive and convenient means of assuring that both power tubes receive the same signal in such an amplifier.

In Fig. 204 R_1 and R_2 are identical, their values of resistance depending on the service. R_3 and R_4 are determined by the tubes used. R_5, depending on the service, must be high enough so that, in the phase-inverter connection, the setting of R_2 will not be too critical. R_6 is 1 megohm, R_7 is a 1-megohm volume control, R_8 is 0.1 to 0.25 megohm, and C_1 is 0.01 μfd. The 6E5 functions as a grid detector; its pattern closes at some given signal level, determined by the setting of R_7.

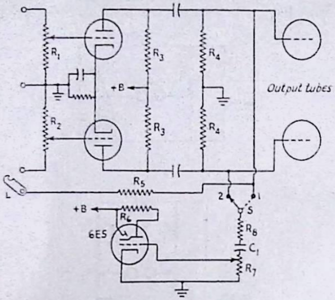


Fig. 204 — **Using a 6E5 indicator tube as a balance indicator in resistance-coupled push-pull or phase-inverting amplifiers. See text for circuit constants.**

For push-pull operation, apply the signal across R_1 plus R_2, leaving link *L* open. Give, for example, R_1 an arbitrary scale. Then, for each setting of R_1, with the s.p.d.t. switch, *S*, in Position 1, set R_7 for exact closing of the pattern; and without changing setting of R_7, flip *S* to Position 2 and mark the setting of R_2 which gives exact closing. Repeat at various levels. This method gives balance independent of the whims of irregular carbon volume controls. Once calibrated these are set to like readings, and the calibration is checked as often as necessary.

For phase inverter operation, apply the signal across R_1. Close link *L*. At any convenient level, set R_7 for exact closing and adjust R_2 so that *S* may be flipped back and forth without change in pattern. R_1 is the volume control and R_2 is not touched again unless necessary on a later check.

It should of course be recognized that there is no compensation for dissimilarity of power tubes, such as when half the filament of a 2A3 burns out unnoticed! — *A. H. Taylor, Cornell University, Ithaca, N. Y.*

Editor's Note. — It is desirable to avoid loading the speech-amplifier tubes, insofar as this is possible, with a grid detector connected across the output circuit. To this end, the sum of R_7 and R_8 should be large compared to the value of R_2. This condition is met by the values specified when the speech amplifier tubes are triodes, as shown in the circuit diagram.

REGENERATIVE AUDIO AMPLIFIER FOR C.W. SELECTIVITY

The circuit of Fig. 205 is effectively an audio oscillator with speaker volume. Omit R_1, T_1 and C_1, which form the input from the receiver, and the audio oscillator is left. In the audio oscillator circuit C_2 is the variable condenser which controls the tone of the audio note, while R_2 is a variable volume control which acts as a sensitivity control.

In operation this control is advanced until audio oscillation is obtained. If no sound is heard, reverse the connections of T_2 on the secondary side. After sound is obtained, C_2 is adjusted to give a desirable pitch, and R_2 is then backed off until audio oscillation just ceases. Any input through T_1 of the same pitch or tone as that to which the audio oscillator has been adjusted cause an audio output of far greater amplitude than the exciting signal and, although other tone frequencies will be heard through the loud speaker, there is an enormous increase in volume when the receiver is adjusted to give the exact pitch to which the audio oscillator is tuned. Unwanted signals of equal or greater strength but of slight difference in tone pitch practically disappear, while atmospherics and other forms of static also are down.

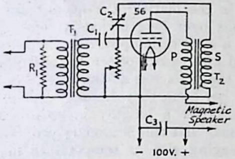


Fig. 205 — A regenerative audio amplifier-oscillator for c.w. selectivity.

C_1 — 250-μμfd. mica.
C_2 — 100-μμfd. variable.
C_3 — 1-μfd. paper.
R_1 — 100,000 ohms, ½-watt.
R_2 — 100,000-ohm volume control.
T_1 — Audio transformer (1:1 ratio).
T_2 — Audio transformer (3:1 ratio).

R_1 is a one-watt carbon resistor for howl suppression. As built this unit has its own power supply, which is separate from the receiver, being connected to the receiver at the headphone jack. It can be used with any receiver which will give c.w. signals. Care must be used in the initial adjustment; after that, all that is necessary is to turn the receiver dial. Tuning of the receiver should be slow, since the tone peak can be passed very quickly. In some cases the band can be first searched for a call and the audio selector then plugged in. — *Chas. E. Diehl, W6EVF.*

—···—

RECEIVER-OPERATED RELAYS

It is often found desirable in the amateur station to make use of received carriers for relay operation. This may be applied to interstation noise suppression, where relay contacts may be used in series or in shunt with the voice coil of a speaker, or it may be applied to automatic reception of code with a fast-operating relay.

Two simple and thoroughly practical circuit arrangements for carrier-operated relays are shown in Fig. 206.

The circuit shown at (A) is that of a grid-leak detector the plate current of which is decreased by reception of a carrier. The armature of the relay is thus held down until a carrier is received, at which time the grid bias of the tube increases, the plate current decreases, and the armature is released. The type of relay shown — single contact closed with no current — may be connected in series with the voice coil of a speaker to make the latter inoperative during no-carrier periods. This type of relay contact also is suitable for keying an automatic recorder or for retransmission of telegraph signals.

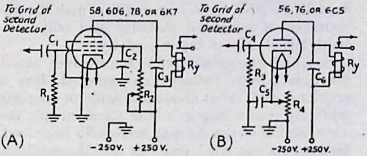


Fig. 206 — Receiver-operated relay arrangements.

C_1, C_2, C_4 — 0.01-μfd. paper.
C_3, C_5, C_6 — 0.1-μfd. paper.
R_1 — 1 megohm, 1-watt.
R_2 — 0.5-megohm potentiometer.
R_3 — 0.5 megohm, 1-watt.
R_4 — 10,000-ohm potentiometer.

R_y is a small d.c. relay designed to operate at approximately 8 milliamperes. Resistor R_2 is adjusted to give sufficient screen voltage to maintain the relay contact open without any received carrier.

Fig. 206-B is the circuit of a plate detector arrangement which operates in the reverse fashion. The plate current of the tube normally is insufficient to operate the relay, but reception of a carrier results in an increase sufficient to pull down the armature. In this arrangement resistor R_4, the bias resistor, is used to control the plate current for proper operation of the relay. If this is used for keying another transmitter, or for other devices requiring a circuit-closing effected by carrier, a relay which makes contact with increased current should be substituted for the type shown. — *James A. Eberhart, W8KKW.*

—···—

AUTOMATIC STOP FOR BAND-SET CONDENSERS IN SUPERHETS

In any receiver using electrical bandspread, with the padding condensers controlled from the front of the panel, the padders must be set very accurately at a predetermined capacity for each band. The sketch of Fig. 207 shows an attachment for the oscillator-padder knob which has neatly solved the band-setting problems at W3HQP. For these padders the usual small dial or pointer, knob and scale has its limitations. An error of a small fraction of a degree in resetting it by eye may throw the bandspread dial calibration off by several kilocycles — enough so that when it's time for a schedule it's necessary to hunt back and forth across the dial until the station wanted comes in.

The automatic stop shown in the sketch makes it possible to set the padder right "on the nose" for any band. A flat spring is made from a piece of spring-bronze weather-stripping (approximately 24 gauge) about ¾ × 1½ inch. The small hump at its left-hand tip bears against the rim of the knob. For each setting of the band-set knob, a notch is filed in the rim. At the right setting the spring clicks into place in the notch — and there you are! The notches need be only 1/32-inch deep or less, and there seems to be no advantage in using a knob of larger diameter unless the notches have to be very close together.

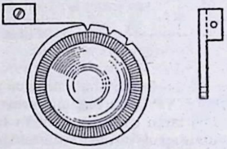


Fig. 207 — An automatic dial stop for controlling the band-set condenser in a communications receiver.

The stop may be useful in many other pieces of gear — in transmitters for example, to speed up the process of retuning for different bands. If appearance is important, the notched knob and its spring might be located in back of the panel, out of sight on an extension of the condenser shaft, and the control of the condenser effected by another knob on the front of the panel. — *Lawrence Fleming, W3HQP.*

—···—

REPLACING A MAGNETIC SPEAKER WITH A D.C. DYNAMIC

Fig. 208 shows a simple method of replacing the old magnetic speaker with an electrodynamic without adding a field supply or modifying the receiver in any way. The field is simply connected in series with the primary of the output transformer and by-passed with a 4-μfd. condenser, thus using the plate current going to the output tube of the receiver to excite the field. — *C. W. Leeds, jr., W3AIU.*

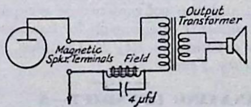


Fig. 208 — Using a d.c. field-type dynamic speaker on sets built for magnetic speakers.

PLUG AND JACKS FOR CHANGING FROM BANDSPREAD TO GENERAL COVERAGE

Almost every ham would like to have a receiver that would cover the entire short-wave spectrum and yet give complete dial-spread of the amateur bands. In some receivers this is accomplished by winding separate coils for each purpose. However, this procedure involves quite a bit of expense. The thoroughly practical and inexpensive idea diagrammed in Fig. 209 is offered as a better solution.

Five- or six-prong coil forms are necessary for the windings, and small trimmer condensers should be provided inside the coil forms — air trimmers are preferable but mica may be used. Hammarlund XP-53 or similar forms are satisfactory. The large coils are easy to handle and have adequate space inside for the midget trimmer condensers.

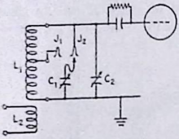


Fig. 209 — General coverage and bandspread tuning by the use of a plug and jacks.

The winding is made so that resonance of the coil alone falls a few kilocycles higher in frequency than the ham band to be spread. The small trimmer condenser in parallel with the winding is then used to set the high-frequency edge of the tuning range so that only a slight margin higher than the high-frequency end of the band is available on the dial.

In the immediate vicinity of the coil socket, two banana-plug jacks are mounted in the chassis in such a position that connections to the grid pin and the coil tap pin lugs of the socket will be short and direct. Making the bandspread tap on the coil is an experimental job, since the position of the tap depends on the capacity of the condenser used for tuning and on the width of the band to be covered. The tuning condenser stator is connected with a flexible wire to a banana plug.

All that is needed to make the receiver full-coverage tuning rather than bandspread is insertion of the plug in the jack connected to the grid-pin lug of the coil socket. The cost of the arrangement is only a few cents; results are excellent; and the convenience is comparable to that of separate plug-in coils for bandspread and general coverage. — *Roy R. Campbell, W4DFR, Lenoir City, Tenn.*

ELIMINATING I.F. SHIFT—A HETEROTONE CIRCUIT

How many amateurs have noticed an apparent shift of i.f. alignment amounting to several kilocycles when the gain control of a superheterodyne is varied? In a receiver under investigation, the input capacity of the i.f. amplifier tubes seemed to change when the bias voltage was changed by the usual variable cathode resistor plus bleeder system.

A look at the properties of tubes shows that the effective input capacity is the sum of several fixed capacities and another which is a function of the voltage amplification and the grid-plate capacity of the tube. From this it appears that a variable-μ tube must have a variable input capacity, since the amplification decreases as the grid bias is increased. The 6K7 has a grid-plate capacity of 0.005 $\mu\mu$fd. and the 6L7 only 0.0005 $\mu\mu$fd., but the maximum gain is nearly the same for both tubes. Therefore, a 6L7 should perform as well as a 6K7 as an i.f. amplifier, with the advantages of increased stability and only one-tenth the change of input capacity.

So a 6L7 was substituted in the receiver, and it functioned even better than expected. But a problem arose. What about the oscillator coupling grid? By connecting it to the a.v.c. circuit, the a.v.c. action of the set was materially improved. Heterotone was tried, coupling into the oscillator grid, with immediate approval.

Fig. 210 shows the modified amplifier and heterotone oscillator. Most values, while not critical, are subject to variation depending on the a.f. transformer used in the oscillator circuit.

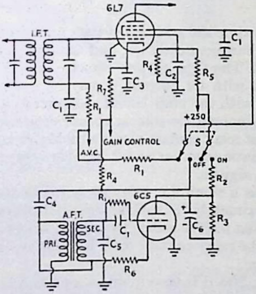


Fig. 210 — **Heterotone oscillator coupled to 6L7 i.f.**

C_1 — 0.01-μfd. paper.
C_2 — 0.1-μfd. paper.
C_3 — 0.5-μfd. paper.
C_4 — 0.25-μfd. paper.
C_5 — 0.002-μfd. paper.
C_6 — 8-μfd. 450-volt electrolytic.
R_1 — 100,000 ohms, ½-watt.
R_2 — 100,000 ohms, 1-watt.
R_3 — 25,000 ohms, 1-watt.
R_4 — 15,000 ohms, 1-watt.
R_5 — 10,000 ohms, 10-watt.
R_6 — 5000 ohms, 1-watt.
R_7 — 400 ohms, 1-watt.
AFT — audio transformer.

The circuit and values were found by cut-and-try. If the 6C5 does not oscillate, reverse the connections to the a.f. transformer primary. The oscillator grid of the 6L7 is connected to the a.v.c. circuit only when the heterotone oscillator is off, in order to maintain a fairly constant percentage of tone modulation. Screen-grid coupling of the oscillator to the 6L7 was found less stable in tone frequency and percentage of modulation than oscillator grid coupling, when the gain control was varied. If the set has one voltage divider to supply all screen voltages, it may be advisable to make changes to keep the screen voltage near 100. — *Wilfred H. Conley, W8CZR.*

CRYSTAL FILTER FOR 'PHONE WORK

I BUILT a receiver here at W6VS using a regenerative preselector, regenerative first detector and one stage of 456-kc. i.f. The receiver had very good sensitivity and output, but lacked selectivity on the crowded 14-Mc. 'phone band. So I purchased a Meissner crystal-filter unit and installed a second i.f. tube — a 6K7. It was found that the selectivity for c.w. was perfect, but much too sharp for understandable 'phone work. A variable condenser across the input coil of the crystal bridge helped very little. I read an article by D. K. Oram in December, 1938, *QST* and decided that I would try that circuit. I removed the tap from the crystal to the center of the i.f. grid input coil and connected a wire directly to the grid of the i.f. stage. I found that this connection gives just about the right amount of selectivity for 'phone use with good discrimination and understandable quality. The circuit change is shown in Fig. 211. — *W. S. Davis, W6VS.*

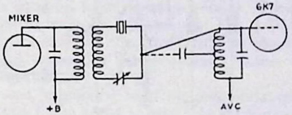


Fig. 211 — Broadening crystal filter for 'phone work. Coupling is shifted from the center-tap to the grid.

* * *

REGENERATION CONTROL

THE performance of the two-tube receiver described in the October, 1937, issue of *QST*, can be improved markedly by operating the screen of the detector at a constant voltage and varying the r.f. feed-back, as shown in Fig. 212.

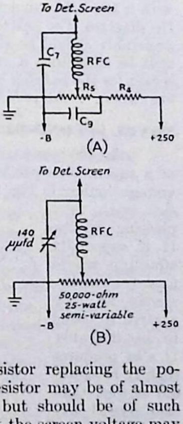


Fig. 212 — Revised regeneration control for the two-tube receiver. (A) is the original circuit; (B) the revised circuit. The values for (A) are the same as those in the original article in the October, 1937, issue of *QST*.

The semi-variable resistor replacing the potentiometer and fixed resistor may be of almost any convenient value, but should be of such physical dimensions that the screen voltage may be easily controlled. A screen voltage of about 25 volts was found to be optimum, a higher voltage causing an annoying and persistent fringe howl.

The electrolytic condenser, C_9, was found unnecessary in the modified circuit, since there is no possibility of scratch from moving contacts.

The advantages of this method of controlling regeneration are: greater stability, since the detector is operating under constant conditions; noiseless control of regeneration with no moving contacts, and fewer necessary parts, making for greater compactness. There is an almost imperceptible transition into and out of oscillation, with complete absence of back-lash.

This method of regeneration control may be adapted to any regenerative circuit with but minor circuit changes. — *Edmond L. Piesen, 48 Franklin Ave., Saranac Lake, N. Y.*

* * *

REGENERATIVE R.F. STAGE USING 6L7 PENTAGRID MIXER

THE circuit shown in Fig. 213 resulted from an attempt to use regeneration in a t.r.f. receiver for best reception of c.w. signals. As the circuit also provides greatly increased gain and is stable in operation, it should interest those amateurs who prefer to use a t.r.f. receiver.

Regeneration is maintained by means of feed-back to the injector grid of the 6L7 r.f. amplifier.

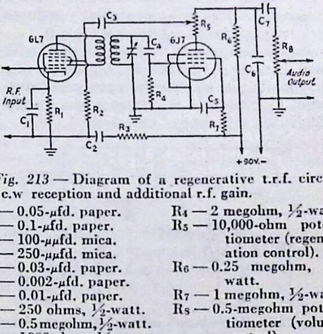


Fig. 213 — Diagram of a regenerative t.r.f. circuit for c.w reception and additional r.f. gain.

C_1 — 0.05-μfd. paper.
C_2 — 0.1-μfd. paper.
C_3 — 100-μμfd. mica.
C_4 — 250-μμfd. mica.
C_5 — 0.03-μfd. paper.
C_6 — 0.002-μfd. paper.
C_7 — 0.01-μfd. paper.
R_1 — 250 ohms, ½-watt.
R_2 — 0.5 megohm, ½-watt.
R_3 — 1000 ohms, ½-watt.
R_4 — 2 megohm, ½-watt.
R_5 — 10,000-ohm potentiometer (regeneration control).
R_6 — 0.25 megohm, ½-watt.
R_7 — 1 megohm, ½-watt.
R_8 — 0.5-megohm potentiometer (volume control).

Using the values shown in the diagram a tremendous amount of regeneration is available, so that it is necessary to reduce it to a practicable degree. This is done by experimenting with the primary of the r.f. coil to secure proper coupling and impedance.

Proper phasing is also important in the r.f. coil. If the circuit will not regenerate, the primary leads should be reversed.

Among the advantages of this circuit is the fact that the regeneration control will have no effect upon circuit resonance. Since the method of feed-back is primarily that of a multivibrator, synchronization with the input signal is easy if the latter is quite close to the resonant frequency. As a result, a wide channel is available for the reception of voice (or even of music) frequencies, even while the circuit is actually oscillating. The zero-beat point will be found to be quite broad.

If the size of the regeneration control is reduced, the circuit will not function as it should. In order to reduce regeneration by any method other than that of adjusting the r.f. coupling and impedance, it is necessary to add a resistor in series with the regeneration control of such a value as to maintain a total of 10,000 ohms in the circuit when the setting of the control is reduced. This method is not practicable on an all-wave or multiband receiver, since the adjustment would have to be varied for each band. Only pruning of the coils would permit a setting for each band such as to secure satisfactory all-wave operation with this method.

Some sort of sensitivity control should be used with the input tube, since this circuit will block easily. One method of accomplishing this would be the use of an a.v.c. circuit, requiring a separate a.v.c. tube. — *L. G. Genung.*

* * *

A PUSH-PULL INFINITE-IMPEDANCE DETECTOR

Although the diode detector is widely used as the second detector in superheterodyne receivers, because it is capable of handling large signal voltages and also because it provides a ready means of obtaining a voltage for a.v.c. purposes, its low resistance greatly reduces the selectivity of the transformer feeding it.

Results comparable to those obtained with the diode detector can be realized by the use of cathode coupling in an infinite input-impedance detector. However, a.v.c. voltage is not readily obtained with this type of detector.

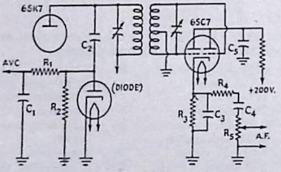


Fig. 214 — A push-pull infinite-impedance detector with a.v.c. voltage obtained from a separate diode.

C_1, C_4 — 0.1-μfd. paper.
C_2 — 50-μμfd. mica.
C_3 — 100-μμfd. mica.
C_5 — 8-μfd. 450 volts electrolytic.
R_1, R_2, R_4 — 1 megohm, ½-watt.
R_3 — 0.1 megohm, ½-watt.
R_5 — 1-megohm potentiometer.
R_6 — 10,000 ohms, ½-watt.

In the circuit shown in Fig. 214, a push-pull infinite-impedance detector is used in connection with a separate diode which supplies a.v.c. voltage from the plate circuit of the i.f. amplifier. This circuit gave good results when installed in a Meissner all-band receiver. It accepts signals of relatively high amplitude without overloading or distortion.

The detector tube used is a 6SC7 dual triode, operated close to cut-off. Suggested circuit values are given in the caption for the diagram. — *C. W. Moorhouse, P. O. Box 242, Chilliwac, B. C.*

THE SW-3 AS A PRESELECTOR

Receivers of the regenerative-detector and r.f.-amplifier type which have been retired from service with due honors often are recalled to work as preselectors ahead of superhet receivers, where they usually do excellent jobs.

In the usual arrangement, a tuned circuit and link are required in coupling the output of the preselector to the input of the receiver. Fig. 215 shows an arrangement which has worked out successfully in which the need for the tuned circuit and link is eliminated by using the audio tube in the regenerative receiver as a low-impedance coupling tube. Only a few changes are necessary in converting the National SW-3 to suit the new requirements. The audio coupling impedance between the detector and audio amplifier is removed. The plate of the former detector is then coupled to the grid of the former audio amplifier through a 500-μμfd. mica condenser and the grid connected to ground through an r.f. choke. The plate of the former audio amplifier is by-passed to ground and the plate voltage fed to it through an r.f. choke. The audio cathode resistance and bypass condenser are removed and a 1000-ohm resistor to ground substituted. The output of the preselector is then taken off across this resistor with a 500-μμfd. condenser in series as shown in the diagram. The link to the input of the receiver preferably should be shielded. It also might be well to substitute a ceramic or other low-loss socket for the bakelite socket in the audio amplifier circuit. — *Louis N. Seltzer, W3COG.*

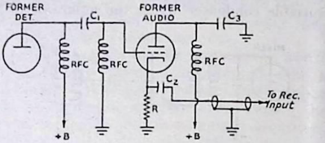


Fig. 215 — W3COG's arrangement for using an audio amplifier as a low-impedance coupling tube when an SW-3 or similar receiver is used as a preselector, C_1 and C_2 are each 500 μμfd.; C_3 is 0.02 μfd. *R* is 1000 ohms.

* * *

NOVEL SECOND-DETECTOR CIRCUIT

A 6H6 diode used as the second detector of a superheterodyne receiver is arranged as a voltage doubler in Fig. 216. I have used this circuit with very pleasing results. It is especially effective where greater automatic volume control is found to be desirable. It also produces slightly more audio output than the usual arrangement. — *Allistair Towle, Mt. Royal, Que.*

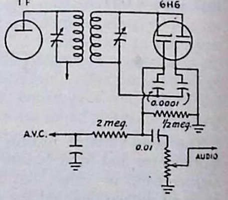


Fig. 216 — A novel second-detector circuit using a voltage-doubling circuit.

A VERSATILE REGENERATIVE-DETECTOR RECEIVER

I BUILT a small regenerative receiver using a 1S4 miniature tube with 9 volts on the plate and the screen. Here are some of the uses which I have found for it:

First, it can be used as a regenerative r.f. stage on a superhet. Both receivers are connected to the same antenna and ground leads, and are tuned to the same frequency. Adjusting the regeneration control will cause the gain of the superhet to increase amazingly. Stations that were inaudible before come up to comfortable volume. The better the regenerator is tuned and the nearer to oscillation it is set, the greater will be the gain. Signal-to-noise and signal-to-image ratios also are improved.

Second, it may be used for code instruction. Recently I was asked to give a code demonstration before a group of about 30 people. The a.f. oscillator I had was a small battery rig for headphone use only. Not desiring to build a larger rig, I let the regenerator oscillate and plate-modulated it through a 3-to-1 transformer, the code oscillator furnishing the audio signal. I tuned this in on a b.c. receiver and had volume to spare.

Third, it may be used as an "induction" transmitter. With the set oscillating and a magnetic speaker, hooked in the positive "B" lead, serving as a microphone, the signal may be picked up on the b.c. set for the amusement of friends.

Fourth, by checking the frequency against a receiver of known calibration, the oscillator may be used to align other receivers.

Last, it is an excellent receiver for portable use, giving good headphone strength on most signals.

The size of the gadget is 4 × 4½ × 2¾ inches. Two standard flashlight cells are used for the 1½-volt "A" battery, while six penlite cells are used to obtain 9 volts of "B" supply. I have wound coils to cover all frequencies between and including the 19-meter and standard broadcast bands. All in all, it is a cheap, useful and interesting device to have around. In fact, I often wonder how I got along without it! — *Robert Price, Laurel, Miss.*

—…—

IMPROVING VOLTAGE/FREQUENCY STABILITY OF THE H.R.O.

I RECENTLY made a couple of changes in my HRO which greatly improved the stability of the high-frequency oscillator, the instability of which had been annoying me when using maximum selectivity on c.w. signals. Slight changes in line voltage, such as those produced by taking more or less power off the line, had a perceptible effect on the oscillator; but more annoying was the fact that adjustment of the r.f. gain control had a marked detuning effect. Also, a strong incoming signal had quite a pulling effect on the h.f. oscillator frequency.

The h.f. oscillator is affected by the position of the r.f. gain control and by strong signals, because the oscillator-screen and mixer-screen voltages are taken off the same high-resistance voltage divider. When the r.f. gain is turned up or when a strong signal is tuned in, the mixer draws more screen current. Thus the voltage drop through R_1 increases, the voltage on the oscillator screen goes down, and the oscillator frequency is thereby changed. Also, of course, turning up the r.f. gain or tuning in a strong signal causes the r.f. and i.f. tubes to draw more plate and screen current. The total load on the power supply increases, and so the voltage on the plates of all tubes, including the h.f.o., drops. The suggested changes, shown in Fig. 217, take care of this, too.

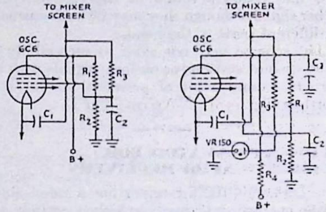


Fig. 217 — HRO receiver circuit changes suggested by W3JVJ for improving voltage-frequency stability.
Left — Original circuit. Right — Modified circuit.
C_1, C_2, C_3 — 0.1-μfd. paper.
R_1 — 50,000 ohms, ½-watt.
R_2, R_3 — 100,000 ohms, ½-watt.
R_4 — 3000 ohms, 5-watt.

Regulation of the plate voltage to the oscillator was effected by putting a VR150 into service with a 3000-ohm resistor in its supply lead. The plate of the oscillator must then be by-passed to ground. The effect of the common screen resistor was eliminated by connecting the detector screen to the oscillator plate through the 100,000-ohm resistor already in the set.

The original circuit is shown at the left, while the revised circuit is shown at the right. The improvement effected has been very gratifying. — *John D. Edgerton, W3JVJ.*

—…—

OPERATING KINK FOR SUPERHET RECEIVERS

IN A superhet receiver the high-frequency oscillator beats with the incoming signal to produce a resultant signal of a frequency equal to that to which the i.f. amplifier is permanently tuned. This principle is well known. It is, of course, possible to receive, simultaneously, signals differing appreciably in frequency by the use of two high-frequency oscillators, each tuned to produce the required i.f. beat.

I have used this idea in an arrangement which makes it unnecessary to retune the receiver when engaged in a "three-way" QSO with two other local hams. The signal from one of these stations is tuned in in the usual manner. An external local oscillator is then used to beat against the signal from the second station to produce the same i.f. If the strength of the signals from the second station and the local oscillator are sufficient, it will not be necessary to provide direct coupling between the local oscillator and the mixer. I use an old regenerative detector as the oscillator and resistance-capacity couple its grid to the antenna terminal of the superhet. All that is necessary then is to tune the regenerative-receiver oscillator until the second signal appears at the same setting on the superhet receiver, when it is unnecessary to retune the superhet to receive either signal although they may be on frequencies in different parts of the band.

The scheme may not work so successfully on more distant stations or on local signals with superhets having a lot of preselection, but it is worth trying. — *J. C. Nelson, W8FU.*

—···—

AUDIO ATTENUATOR FOR NC100 AND NC101 RECEIVERS

My NC100X receiver has a rated audio power output of 10 watts, which is entirely too much for a small room. When the gain is turned down to a comfortable level, however, a certain amount of hum and distortion is introduced.

To overcome this I inserted a small T pad between the output transformer and voice coil, as shown in Fig. 218. The results were remarkable. The quality is very much improved and the hum is no longer noticeable. Although the tubes are still working near maximum output, the speaker does not blow me out of the room.

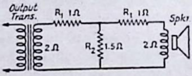


Fig. 218 — Circuit for T attenuator to maintain quality audio from NC100 and NC101 receivers at low-output levels. Values are for a 2-ohm voice coil.

The resistance values shown in Fig. 218 are selected to give 10 db. attenuation with the 2-ohm speaker furnished with the NC100 and 101 receivers. Two-watt resistors are capable of dissipating the required power. I used two 3-ohm units in parallel to obtain the 1.5-ohm value.

Resistor values for 10-db. attenuation with other impedances may be determined from the following equations:

$$R_1 = 0.52Z \qquad R_2 = 0.17Z$$

where Z is the speaker impedance. — *J. B. Hill, jr., W9OPJ.*

—···—

AIR VENT MAKES HEADPHONES MORE COMFORTABLE

If a small hole of about No. 50 drill size is pierced through the side of each cap of a pair of headphones, as shown in Fig. 219, an appreciable increase in comfort is secured for the wearer. The vents serve to equalize the air pressure between the 'phone diaphragms and the ear diaphragms. The holes are small enough so that no additional outside noise is admitted, nor is there any noticeable acoustic leakage through them. The effect is to eliminate that drumlike sound and to relieve the stuffy feeling that comes from wearing headphones for long periods of time.

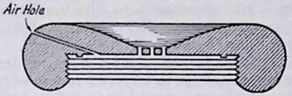


Fig. 219 — Headphone cap with vent drilled through the side to equalize air pressure for comfort.

This "operation" has been performed for about twenty hospital patients who wear 'phones in bed. All report a big improvement in comfort. — *B. P. Hansen, W9KNZ.*

—···—

HEADPHONE CONNECTIONS IN B.C. RECEIVERS

A good method of connecting headphones into a receiver without upsetting the normal plate load is to place a switch in the voice-coil circuit so that the voice coil may be cut out and an equivalent resistance substituted, as shown in Fig. 220. The headphones may be connected in all the time, since they do not impose much additional load on the tube. Alternatively the volume control, R_2, may be fitted with a switch to open up the circuit. — *Roy Usher, VE4EA.*

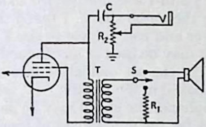


Fig. 220 — Circuit diagram showing another method of connecting headphones in the b.c. receiver output.

C — 0.01-μfd (or larger) paper.
R_1 — Resistance to match speaker voice coil; usually 4 or 5 ohms, 10 watts.
R_2 — 0.1-megohm potentiometer.
S — S.p.d.t. toggle switch.
T — Receiver output transformer.

—···—

LISTENING ON 600 METERS

Some of the gang who like to take a listen on 600 meters may be somewhat disappointed with the results. Here at WPDO we have an NC200 which just covers the distress frequency of 500 kc. With the receiver connected to an average antenna the results were very poor. Even when the 2808-kc. transmitting antenna was used very little improvement was noticed. Signals picked up greatly, however, when a series-tuned circuit was added in the ground lead. This consisted of a 3-inch coil of 75 turns and a 4-gang condenser from an old t.r.f. b.c. set, with all sections tied in parallel.

Reception at night is excellent. I have heard Argentine coastal stations at good strength. No interference is experienced from the local b.c. stations nor from the 250-watt police transmitter operating in the same room.

The importance of a tuned antenna for receiving on the low frequencies is well known to some of the older gang, but some of the younger fellows may not be as well acquainted with the point. — *C. Belvin, W8LVV.*

—···—

Re listening on 600 meters. I thought I would try the use of parallel condensers to pad the main tuning gang of my RME-69 communications receiver to get response at the lower frequencies. In my case, it worked out great. Small fixed condensers are connected with clips, since the leads are easy to get at — and they can be taken out just as easily. — *Bert Brown, W9FS.*

—···—

TONE CONTROL BY NEGATIVE FEED-BACK METHOD

An exceptionally wide-range control, from high treble to deep bass, is obtained with the circuit shown in Fig. 221. With the arm of the potentiometer at "*A*" the 250,000-ohm grid resistor is shorted out and the 0.05-μfd. plate condenser is connected as a by-pass to ground, giving maximum bass. With the arm at "*B*" the 0.05-μfd. by-pass is high above ground and the feed-back voltage is maximum, with feed-back taking place only at low frequencies due to the 0.006-grid shunt. The high audio frequencies are passed and the lows attenuated at "*B*." — *Willard Moody.*

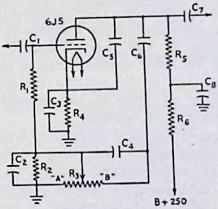


Fig. 221 — Circuit for wide-range tone variation.

C_1, C_4, C_6, C_7 — 0.05 μfd. paper.
C_2 — 0.006-μfd. paper.
C_3 — 10-μfd. electrolytic.
C_5 — 100-μμfd. mica.
C_8 — 0.5-μfd. paper.
R_1, R_2 — 0.25 megohm.
R_3 — 2-megohm potentiometer.
R_4 — 3000 ohms.
R_5 — 50,000 ohms.
R_6 — 0.1 megohm.

—···—

AUTOMATIC BIAS FOR BATTERY TUBES

Many transceiver and transmitter-receiver circuits for 1.4-volt tubes specify a "C" battery as the grid-bias supply for the power-output tube. Space and weight may be saved by using a biasing resistor in place of the battery.

As shown in Fig. 222, the biasing resistor, *R*, is connected between "B" — and the grounded side of the filament, while the grid return is made to negative "B." Thus the voltage drop across the resistor is applied as bias to the grid, in the same manner as cathode bias in a.c. circuits. The plate voltage is reduced by the amount of the biasing voltage, of course, but this reduction will be negligible for the small value of bias required for most types of tubes used in portable battery rigs. A value of resistance should be selected which will produce a voltage drop equal to the required bias. The total "B" battery current drawn by all tubes must be used in calculating the resistor value.

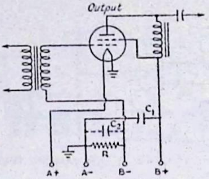


Fig. 222 — Circuit diagram showing a method of applying resistor bias to battery tubes in transceivers.

The same bias may be applied to the grid of a driver tube by connecting its grid return at the same point. If the driver tube requires a lower bias than the output tube, this may be obtained by returning the grid of the driver tube to a tap on the resistor or by using two resistors in series.

Aside from eliminating the need for a "C" battery, the use of resistor bias has the added advantage of automatically maintaining the grid-bias plate-voltage relationship in proper proportion as the "B" battery voltage drops off with use.

C_1 is the usual plate by-pass provided to offset the conditions caused by increasing internal resistance of the "B" battery. C_2 (an electrolytic low-voltage high-capacity midget), shown in dotted lines across the bias resistor, is used only if the improvement in audio quality justifies its use. — *Loyal S. Fox, ex-W2AHB.*

—···—

PROTECTIVE DEVICE FOR BATTERY-OPERATED RECEIVERS

In order to prevent burning out filaments of battery-operated tubes while trying out breadboard layouts and general experiments, put a resistor in series with the "B" battery right at its terminal, as shown in Fig. 223. A value of about 2500 ohms per 45 volts of "B" battery will not appreciably lower the voltage supplied to the load but will prevent the passing of sufficient current to burn out any filament in case of short circuits and slips. It will also protect the "B" battery itself. — *V. L. Robbins, Esquimalt, B. C.*

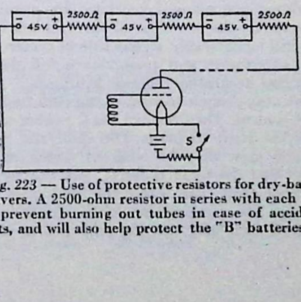


Fig. 223 — Use of protective resistors for dry-battery receivers. A 2500-ohm resistor in series with each block will prevent burning out tubes in case of accidental shorts, and will also help protect the "B" batteries.

RESONANCE INDICATOR FOR F.M.

A CIRCUIT which has been developed commercially is shown in Fig. 224. At resonance, the shadow angle is zero, since the 6E5 is biased to cut-off and no voltage is delivered by the 6H6. A voltage regulator tube insures stable operation, and the accuracy is practically equivalent to that obtainable with the more costly zero-center galvanometer method. — *Willard Moody.*

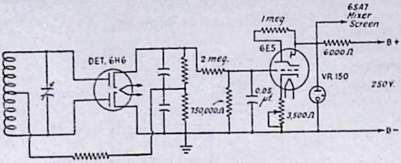


Fig. 224 — Diagram of inexpensive resonance indicator for f.m.

—···—

GANGING VOLUME CONTROLS

IT SOMETIMES arises that a ham has need of a special dual or triple volume control for which a satisfactory substitute cannot be found in the catalogs. By use of the following method, any values of resistance and taper may be combined in any number of controls up to four or five, depending on the length of shaft desired.

It so happens that the Mallory-Yaxley type of volume control is easily ganged in the home workshop. The first step is to remove the shell (including the cover plate) of the control which is to be in front. This is done by prying out the three ears holding the shell on the main assembly. The cover plate should be soldered to the shell at several points around the edge.

Then measure carefully to find the center point of the cover plate. Scribe a cross on the plate at the exact center. With a pair of dividers, scribe a ⅜-inch circle about the center. As a substitute, measure 3/16-inch in four directions and trace around a volume control bushing or other similar-sized object. Punch the center mark with a sharp center punch and drill through carefully, using the smallest drill you have, to reduce errors which might be caused by "walking" of the drill. Gradually increase the size of the drill until the ear of the coverplate falls off. The hole should now be finished with a small rat-tail file. If drilling or reaming is continued, the unbalance of metal on the two sides of the drill will move the drill considerably to one side of center. The final appearance and performance will depend upon how accurately this hole is drilled.

The next thing is to remove the shell from the other control. Then remove the C washer which holds the shaft in place. The shaft and wiper assembly now may be removed (being careful not to lose the roller contact), followed by the resistance strip. This leaves the front plate and bushing. The bushing should be cut down to about ⅛ inch long, leaving only two or three threads on it. This plate and the rear shell of the front control now may be assembled with a ⅜-inch nut. A washer or two probably will be required between the two, to take up the space where the bushing is not threaded. Now replace the resistance strip in the rear control and insert the wiper shaft through the bushing.

The shaft and wiper of the front control should now be removed and the wiper assembly pried off the shaft, being careful not to crack the phenol fiber insulation. The hole in this piece should be reamed out to ¼ inch. Go easy when nearing the final diameter! Ream from both sides and try it on the knob end of the shaft at intervals, stopping when it can be just wedged on without forcing.

The next move requires some dexterity. Insert the roller contact in the rear wiper assembly. Hold the control in the left hand, pushing against the wiper (back) end of the shaft with the index finger to provide about the same spring tension as a new control would have. Slide the resistance strip and front plate of the front control into position onto the shaft. Then, holding the tension to its final value, scribe the location of the end of the bushing on the shaft. Remove the shaft (watching the roller contact), clamp the shaft in a vise, and saw a slot around the shaft about 3/16 inch or so deep at the scribed mark to accommodate the C washer.

Now comes the final assembly. Re-insert the shaft and slide on the front wiper. Align the two wipers to the same relative position on the shaft, then turn both wipers to about middle position. With the roller contacts placed in both wipers (holding the control shaft up will help to keep them in place), slide on the resistance strip and front plate of the front control. The position of the front wiper should now be adjusted to exert about the same pressure on its resistance strip as the rear one, with the control held together. A drop of cellulose cement on the front wiper will hold it in place on the shaft. If the wiper is tight enough, this should not be necessary; if it is done, however, the wiper and shaft should be cleaned with carbon tetrachloride. After the alignment of the two wipers is checked, the C washer should be snapped on the shaft and clinched. Now the ears on the front control may be bent over and the rear shell attached in the same manner.

A switch may be attached to the gang with no modifications using the ordinary procedure. If reasonable care is exercised in its construction, a workable unit with good tracking of resistance can be obtained which is suitable for Hetrofils and Wein bridge, *R/C* oscillator circuits, and L, T and H pads. — *Cpl. David A. Kemper, W2NTX.*

—···—

'PHONE CORD HINT

To keep my 'phone cords from twisting, I bought one of those twisted rubber cords which are used on telephones. It fits over the 'phone cord in the manner in which it is used with telephone cord. I paid a dime for the one I use. —*W9YGR.*

3. *Hints and Kinks . . .* for the Transmitter

GETTING RESULTS WITH THE PIERCE CRYSTAL OSCILLATOR CIRCUIT

Many of us are attracted by the simplicity of the Pierce crystal oscillator circuits. However, there seems to be an abundance of grief connected with getting them to operate properly. Extremely active crystals such as AT or Y cuts usually work satisfactorily but the ordinary variety of X-cut plates display a marked tendency to do just nothing. The following suggestions may be of help to those having trouble with the circuit.

Fig. 301-A will be recognized as the usual type of Pierce oscillator. With many crystals this circuit performs perfectly. With many others of good make it absolutely refuses to produce any output. A 50-$\mu\mu$fd. variable condenser connected between the grid and the cathode, as shown, will permit the use of any crystal. The adjustment of this condenser is fairly critical and should be made with care so that the crystal r.f. current will not rise to a value sufficient to fracture the crystal. The smallest amount of capacity which will cause reliable operation should be used. The same idea applies to the ordinary triode version of this circuit, except that perhaps a larger condenser may be needed.

Fig. 301-B also is a well-known circuit and is often recommended for harmonic operation. More frequently than not the second harmonic is absolutely nil. This is because the Pierce triode circuit utilizing the screen grid for its "plate" must be capable of oscillating of its own accord when delivering output on the second harmonic. The regular plate circuit is merely an amplifier of the second harmonic. The crystal circuit should oscillate even if the plate coil is removed. If it does not, there will be no second harmonic output in a properly operating circuit. The answer again is to place a small variable condenser between the grid and cathode of the oscillator tube. The adjustment of this condenser is rather critical and, as with the Tri-tet circuit, it should be set to give the greatest output consistent with the lowest crystal current. When operating on the fundamental frequency, this condenser should be set at zero or preferably removed from the circuit. All the usual rules that apply to Tri-tet circuit operation should be observed.

Only tubes with negligible plate-to-grid capacity should be used for fundamental operation unless provision is made to reduce greatly the amount of regeneration in the circuit.

A word about the crystals and their holders would not be out of place. The crystal holder plates should be ground to a smooth flat surface the same as the crystal itself. Warped plates are the cause of many crystal troubles. Both the crystal and the plates should be thoroughly cleaned with carbon tetrachloride and great care taken not to touch them with the fingers afterward. The pressure exerted by the crystal holder spring often causes erratic operation. Ready-mounted crystals are usually adjusted at the factory. When crystals are changed from one holder to another it would pay one to experiment a little with the pressure of the spring in the holder. In some cases failure to oscillate may be caused by excessive capacity between the plates of the crystal holder. The remedy is to replace one of the plates with one of smaller size. Disks or square plates about one-half inch across have proved very satisfactory with 80-meter crystals. — *Ed. Preston, W8CSE.*

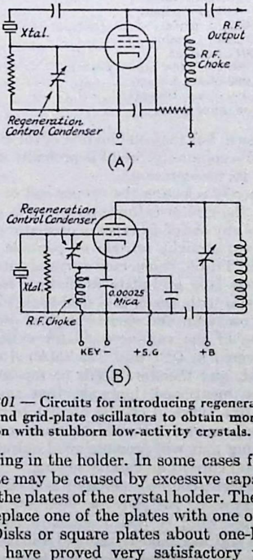


Fig. 301 — **Circuits for introducing regeneration into Pierce and grid-plate oscillators to obtain more reliable operation with stubborn low-activity crystals.**

COMPOSITE OSCILLATOR

The composite oscillator shown in Fig. 302 should prove attractive to the amateur to whom the smell of soldering reacts as a perpetuating tonic — the circuit-changer eternal and the experimenter.

Primarily the chief advantage in the arrangement is its extreme flexibility in adapting itself to purposes for which modern oscillators are generally designed. Each of the various circuits is well known, but the combination of these oscillators into a composite circuit is probably new and justifies its presentation.

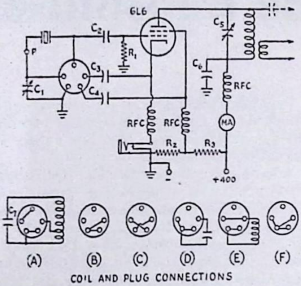


Fig. 302 — Experimental oscillator circuit suggested by W6SM and W7HXM. By inserting different plug-in units in the socket, six different circuit combinations are obtained: (A) e.c.o.; (B) variable-frequency crystal; (C) screen feed-back crystal; (D) grid-plate crystal circuit; (E) Tri-tet circuit; (F) tetrode circuit.

C_1 — 300-μμfd. variable.
C_2, C_8 — 250-μμfd. mica.
C_3, C_6 — 0.01-μfd. paper.
C_4 — 0.002-μfd. paper.
C_5 — 100-μμfd. variable.
C_7 — 0.001-μfd. mica.
R_1 — 20,000 to 50,000 ohms, 1-watt.
R_2 — 50,000 ohms, 1-watt.
R_3 — 15,000 ohms, 10-watt.
P — 60-ma. pilot lamp.

By merely selecting the proper coil or plug-in unit for the grid or cathode circuit, it is possible to secure any one of six types of oscillator circuits, as follows: straight tetrode or pentode crystal oscillator, Tri-tet, regenerative crystal with choke in cathode (the grid-plate oscillator), regenerative crystal with screen-grid feed-back, electron-coupled oscillator and variable-crystal oscillator.

Tuning of the various oscillator circuits has been covered in *QST* and *The Radio Amateur's Handbook*, and therefore needs no repetition. It might be mentioned, however, that tuning of regenerative types of crystal oscillators requires careful adjustment of the regeneration condenser to a setting that will promote good output with safe crystal current and stable keying.

The electron-coupled oscillator is used chiefly for emergencies, but may be used for regular fixed-station work, provided oscillator voltage is regulated and mechanical, thermal and electrical constants are stabilized. Much has been written of late on the e.c.o. and its ills and cures, but for the most part, the proper construction of this type of oscillator calls for isolation, stabilization and complete shielding of the oscillator itself from the following stages of the transmitter. Unless these precautions are taken, the e.c.o. circuit, shown in Fig. 302, is recommended for experimental work only.

The condenser, C_1, tunes the e.c.o. and Tri-tet coils and is used for regeneration control of the screen-grid feed-back oscillator. Therefore it should be of sufficient size to cover its various uses. A condenser of smaller capacity than that recommended probably would cause erratic operation in regenerative crystal oscillators. It may be as high as 500 μμfd., although some difficulty might be encountered in setting frequency with the e.c.o. while doubling or quadrupling.

A fixed high capacity is connected across the e.c.o. coil for stability and is mounted inside the coil form. The crystal need not be removed when using the e.c.o.

If a 6L6 is used, sufficient output should be obtained to drive a buffer-doubler or amplifier requiring a driving power of approximately 10 to 20 watts, which should be ample for most applications. — *L. H. Dunning, W7HXM, and R. H. Lindquist, W6SM.*

—···—

ANOTHER HARMONIC-OUTPUT OSCILLATOR CIRCUIT

In the oscillator circuit shown in Fig. 303, the tube may be either a tetrode or a pentode with suppressor connected internally or externally to cathode. This choice was made because electron coupling could be employed and the output circuit has little effect on the grid circuit with screen and plate coupled in this fashion. The screen and cathode together with condensers C_2 and C_3 form the oscillator proper. With no separate tuning coil employed in the oscillator portion of the circuit, band changing is simplified and fewer parts are used.

If the operation of the oscillator is confined to use with 160- and 80-meter crystals, a 50- to 75-μμfd. fixed condenser may be substituted in the circuit for the 100-μμfd. variable condenser

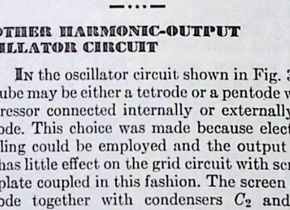


Fig. 303 — A harmonic-output type of crystal oscillator with one tuned circuit.

C_1, C_2 — 100-μμfd. variable.
C_3 — 50-μμfd. mica.
C_4 — 0.002-μfd. mica.
R_1 — 40,000-ohm, 2-watt carbon.
L_1 — Output tank coil, determined by frequency band.

shown, reducing the cost of the oscillator and simplifying adjustment.

Excellent harmonic output can be obtained with this arrangement. The second harmonic nearly equals the fundamental output, and the fourth-harmonic power is appreciable.

The oscillator operates in the following manner: The screen grid acts as a plate (similar to Tri-tet operation), the 50-μμfd. condenser blocking the direct current and providing one part of a capacity voltage divider for the r.f. voltage developed in the screen circuit. The 100-μμfd. variable condenser acts as a by-pass for the screen circuit and the crystal grid circuit, being common to these two circuits but not to the plate circuit, thus providing the feed-back from screen to grid necessary for oscillation. Experiments have shown that the plate-circuit isolation is excellent. Interaction from tuning and loading is reduced to a minimum. Frequency change with tuning of the plate-circuit is negligible.

The size of the grid-leak resistor may be determined experimentally for best fundamental or harmonic output, depending on the major use of the oscillator. The 40,000-ohm resistor shown should be satisfactory for harmonic operation. Voltages as low as 160 on the plate and 75 on the screen, and as high as 480 volts plate and 250 volts screen have been used with entirely satisfactory results. The simplicity of construction and adjustment makes this oscillator a very worth-while unit for the amateur station. — *Donald A. Bush, W8ONW.*

6E5 CRYSTAL OSCILLATOR AND METER SUBSTITUTE

While designing a portable transmitter it was discovered that the 6E5 would function as a crystal oscillator and at the same time act as an indicator of r.f. resonance. The final transmitter, consisting of a 6E5-802 r.f. line-up with suppressor grid modulation, proved to be an excellent one. Naturally in such a stand-by outfit simplicity and ruggedness are paramount, hence the elimination of the crystal plate milliammeter is quite an item.

Referring to the circuit in Fig. 304, when *L* and *C* are not in resonance with the crystal the fluorescent disc of the tube shows a triangle formed by overlapping of the edges. This segment is a brighter green than the rest instead of showing the customary shadow. When *L* and *C* resonate with the crystal the triangle becomes twice as large and has the appearance of being "misty."

This circuit will oscillate if the crystal is removed. This condition will be obtained only if there is no coupling between the plate coil and the r.f. choke. This choke should be made by removing turns from the secondary of an ordinary b.c. transformer until the fundamental of the coil is in the neighborhood of 1700 kc. if the low-frequency band is used, and to corresponding proportions for the other bands. Under these circumstances, with the crystal plugged in, the circuit functions as a locked oscillator with the very desirable property of staying in step with the crystal through ten or fifteen degrees of dial rotation. Crystal locking is easily observed, since the shadow is definitely larger when the crystal takes control of frequency.

In the design of an outfit likely to be used for emergency service, this locked crystal circuit has several advantages over a straight crystal circuit; the transmitter will never be without excitation even though not on crystal frequency, and QSYing to dodge QRM is also possible.

Good output can be secured on the crystal frequency without utilizing the locking system by coupling the grid choke to the plate coil (with the crystal out of the circuit) inversely or in the degenerative direction. Use just enough coupling to kill self-oscillation throughout dial rotation. Then, when the crystal is plugged in, the output will be only on crystal frequency and of surprising strength.

A fortunate feature of this circuit is that nothing is critical about the whole set-up; the output is so stable that the plate terminal may be touched with the finger without stopping oscillation. The adjustment of the degeneration coil likewise is not critical; it is not the hair-breadth setting that the old style regenerative receivers required. While the "magic eye" pattern shows the characteristic crystal dip, the dial setting is several degrees broader than with a conventional pentode oscillator. The power output, as measured roughly with light bulb loading and also by exciting a suitable transmitter, compares favorably with the power from a 41 oscillator used at the same plate voltage.

This circuit worked so beautifully right from the start that no particular pains were taken to develop its possibilities to the fullest extent. A little experiment may bring out other advantageous features. One thing that was done was to attempt to use it in the conventional circuit using a resistor in series with the grid choke. This resulted in very low output, regardless of the value

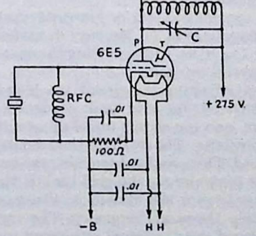


Fig. 304 — A 6E5 crystal oscillator, using the "magic eye" section as a resonance indicator. *L* and *C* are the ordinary resonant circuit capable of tuning to the crystal frequency. The "r.f. choke" is actually a t.n.t. type coil used to provide regeneration and self-oscillation; the circuit is that of a locked oscillator.

of the resistor. This use of the 6E5 does not result in shortened life, apparently, since the circuit has been used as an exciter in a transmitter here for a period of two months with no indication of tube weakening. No attempt was made to use the tube with more than 275 volts; a little experimenting here may or may not be worth while. — *A. R. Richards, W8NFM.*

—•••—

VARIABLE CRYSTAL FREQUENCY WITH AN 815 LOCKED OSCILLATOR

Fig. 305 shows the circuit of a locked-oscillator arrangement which has been giving a very good account of itself at W8KDG. The circuit consists of a conventional push-pull, tuned-plate tuned-grid oscillator circuit with the controlling crystal connected across the grid tank circuit.

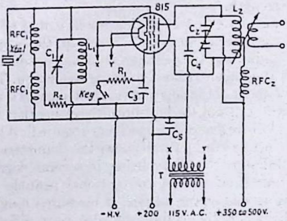


Fig. 305 — Circuit diagram showing use of the 815 as a variable-frequency locked oscillator.

C_1 — 100-μμfd. variable.
C_2 — 100-μμfd. per section.
C_3, C_4, C_5 — 0.01 μfd.
R_1 — 250 ohms, 10-watt.
R_2 — 15,000 ohms, 1-watt.
RFC_1 — 2.5-mh. r.f. choke.
RFC_2 — 1-mh. 300-ma. r.f. choke.
L_1 — 56 turns, 1½-inch diameter, 1¾-inch long (National AR80, no link).
L_2 — 40 turns No. 20, 1⅞-inch diameter, 2¼-inch long (B & W JCL-80).
T — 6.3-volt filament transformer.

A type 815 is used, since its low-excitation requirements eliminate danger of possible high crystal currents.

With any good X-cut or low-drift crystal, the output frequency at 3.5 Mc. may be varied over a range of 7 to 10 kc. without losing the characteristics of crystal control.

In first adjusting the circuit the plug-in coil, L_1, is removed, the grid tank condenser set at minimum, and the circuit tuned up as a straight crystal oscillator. The crystal is then removed and L_1 replaced. Then, without touching the tuning of the plate tank circuit, the grid tank is tuned to give output, as a self-excited oscillator, at approximately the same frequency. The crystal is then replaced and the signal monitored to determine the range of tuning of the grid tank circuit over which crystal-control characteristics will be obtained. This is readily determined, because the note becomes rough as soon as the lock is broken. When one has become accustomed to the tuning of the circuit, the separate steps will not be necessary and it will be simply a matter of plugging in the crystal and grid coil and tuning up.

The unit at W8KDG is built up in two decks, with the grid components below and the plate-circuit elements above. This permits short leads and keeps the two circuits isolated, which is desirable for best results.

For greatest variation in frequency, the input should be limited to 25 watts. Inputs as high as 60 watts may be used without danger to the crystal, but the lock does not hold over so great a range of frequencies.

—•••—

NOTES ON E.C.O. DRIFT

After building the v.f.o. described by W6CUH in the September, 1939, issue of *QST* following the diagram as closely as possible, I found it had a tendency to drift to a higher frequency after plate voltage was applied. It shifted approximately 5 kilocycles in a period of 3 minutes, and no amount of temperature compensation would eliminate the drift.

To cure it the filament coil, which W6CUH uses interwound with the cathode or grid coil, was removed and one side of the filament grounded directly. The other side was by-passed through a 0.002-μfd. mica condenser, both connections being made right at the tube socket. The drift was reduced to a 30-cycle change in 75 minutes of continuous operation. This may be of help to others who may run into same problem. The circuit diagram is shown in Fig. 306. — *Walter King, W7ETK.*

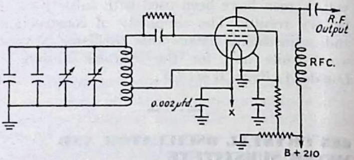


Fig. 306 — Alteration made by W7ETK in his crystal-e.c.o. circuit to reduce frequency drift.

—•••—

E.C.O. COUPLING CIRCUIT

I have found the circuit shown in Fig. 307 very efficient for coupling an e.c.o. to an existing crystal oscillator. Coupling the e.c.o. to the rig is

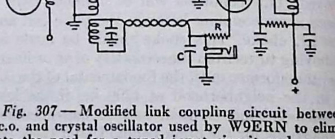


Fig. 307 — Modified link coupling circuit between e.c.o. and crystal oscillator used by W9ERN to eliminate the need for a tuned input circuit and prevent oscillation in the crystal-oscillator circuit.

somewhat of a problem when the transmitter is located some distance away. Ordinary link coupling, while efficient, requires the use of an additional tuned circuit at the transmitter which, in this case, is eliminated with good coupling efficiency. Since the control grid of the crystal oscillator is grounded, there is no danger of oscillation when the 6L6 is operated as a straight amplifier. — *John Clemens, W9ERN*.

—···—

ADAPTING THE 6L6 "GRID-PLATE" OSCILLATOR FOR FUNDAMENTAL AND HARMONIC OPERATION

The "grid-plate" crystal oscillator is very popular because it will stand loading to a degree which would prevent the operation of a straight pentode or tetrode oscillator. It will key smoothly under these adverse load conditions and, best of all, it will work with almost any crystal.

The circuit is sometimes suggested for harmonic operation but in the majority of cases the only result is disappointment. Unless a crystal of extremely high activity is used, there is seldom satisfactory harmonic output. Even with very active crystals, it is usually impossible to key the oscillator when the plate circuit is tuned to a harmonic. In various issues of *QST* and the *Handbook*, a very excellent solution to the problem has been set forth, namely, the changing of the crystal oscillator from the "grid-plate" circuit for fundamental operation to the Tri-tet circuit to obtain harmonic output.

The circuit acts exactly like the regular Tri-tet when a small capacity is connected between the grid and the cathode of the "grid-plate" oscillator and the output compares very favorably with it. With the Tri-tet the cathode coil must be removed from the circuit when it is desired to operate on the crystal frequency. In the case of the "grid-plate" oscillator, the extra grid-to-cathode capacity must be cut out. Fig. 308 shows how this simple change may be made with a s.p.s.t. switch which may be of either the toggle or rotary type.

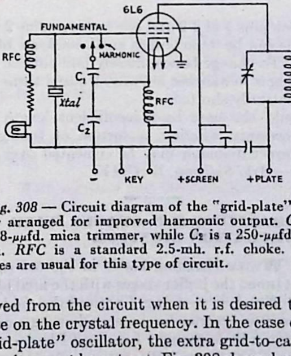


Fig. 308 — Circuit diagram of the "grid-plate" oscillator arranged for improved harmonic output. C_1 is a 70–88-μμfd. mica trimmer, while C_2 is a 250-μμfd. fixed mica. *RFC* is a standard 2.5-mh. r.f. choke. Other values are usual for this type of circuit.

In a small oscillator-transmitter built by the writer, shifting from 3.5 to 7 Mc. and tuning the rig were done with a single knob. The plate tank circuit was designed to cover both bands with a single coil. One band was reached near the maximum setting of the condenser and the other band near the minimum end. The condenser was of the type with a shaft at both ends of the rotor. A toggle switch was coupled by a spring coupling device to the rear shaft of the tuning condenser so that as the condenser was turned toward maximum or minimum the switch was operated and the proper circuit was in use for either fundamental or harmonic operation. — *Ed Preston, W8CSE.*

—···—

IMPROVING THE PIERCE CRYSTAL OSCILLATOR

In common with a great many amateurs, the writer has a "portable-emergency" transmitter employing the popular 6C5 untuned Pierce oscillator driving a 6L6 amplifier. After extended periods of transmission, it was noticed that the crystal holder became very hot. When a 150-ma. pilot bulb was placed in series with the crystal, it was lighted to more than full brilliance. Reducing the plate voltage to a point where the crystal r.f. current was brought down to a more reasonable value caused a great reduction in output. Just as I had decided to abandon the idea of the Pierce oscillator, I ran across a solution to my problem in the *RCA Guide for Transmitting Tubes*. It is a very simple solution, since it necessitates only the substitution of a resonant coil, L_1, for the usual plate r.f. choke (see Fig. 309). This coil is resonant at a frequency somewhat lower than the crystal frequency. Where crystals on several bands are used, the coil is wound for the lowest-frequency band and turns are shorted-out for the higher-frequency bands. Since different amateurs may not use the same circuit layout, coil-form size, or wire size, it would be difficult to specify a certain coil for all occasions. However, the adjustment of the coil is simplicity itself. If it is too large, the crystal current will be high; if too small, the circuit will not oscillate. The best procedure is to place a 60-ma. pilot bulb in series with the crystal and use a plate voltage *not greater than 150 volts*. Start with a coil of 200 turns or so for 160 meters, or about 125 turns for 80 meters. One coil which worked satisfactorily in my transmitter consisted of 85 turns of No. 24 enameled wire, close-wound on a 1-inch diameter form. Turns should then be removed, a few at a

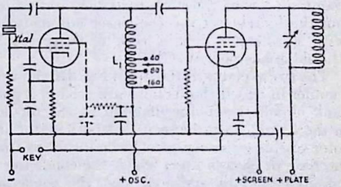


Fig. 309 — W8CSE replaces the usual plate-circuit r.f. choke with a self-resonant coil in his Pierce crystal oscillator to obtain reduction in crystal r.f. current. Other values are usual for this type of circuit.

time, until the pilot bulb barely ceases to glow. If the coil is to be tapped for operation on more than one band, the tap will be located at a point which gives reliable operation with the lowest crystal current.

In addition to the reduction of crystal r.f. current, it will be found that the circuit has greater output for a given plate voltage. The circuit will key smoother with "cranky" crystals and the value of the feed-back condenser will not be at all critical. It is recommended that the article in the *RCA Guide for Transmitting Tubes* be read for further information.

With this circuit properly adjusted it has been found possible to operate a 6L6G with 600 volts on the plate with less than 60 ma. crystal r.f. current! — *Ed Preston, W8CSE.*

—•••—

OBTAINING PROPER CAPACITY RANGES ON DIFFERENT BANDS

Use of a split-stator condenser for a circuit requiring a wide range of capacities, and switching the sections of the condenser automatically with a four-pin plug-in coil, is suggested by Harold Johnstone, W7GDB.

The two sketches at the top of Fig. 310 show the manner in which the sections are used in a plate tank circuit. From the diagram at the top left in the figure, it can be seen that both stator and rotor of this condenser should be insulated from the base or chassis upon which the condenser is mounted and, in addition, that the condenser should be well separated from the panel unless the latter provides thorough shielding. An excellent method of mounting this condenser would be the use of stand-off insulators as mounting feet and of an insulated shaft with flexible coupling for the purpose of adjustment.

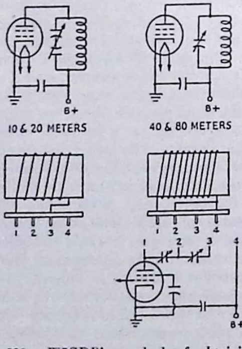


Fig. 310 — W7GDB's method of obtaining two capacity ranges with a split-stator condenser.

The condenser used by W7GDB in this arrangement has a maximum capacity of 100 μμfd. per section. On 28 and 14 Mc., this gives a maximum capacity of approximately 50 μμfd. across the tank circuit, and a minimum capacity of approximately half the single-section minimum capacity. For these bands, furthermore, the insulation in the variable condenser provides a longer leakage path than on the lower-frequency bands. The maximum and minimum capacities specified on 7 and 3.5 Mc. are the values for a single section.

The sketches in the middle of Fig. 310 show the manner in which the four contact pins of the coil are utilized for switching the condenser sections, and the circuit at the bottom of the figure shows the corresponding socket connections. As will readily be seen, this method will work equally well with tube-socket plug-in coils as with the type shown in Fig. 310.

—•••—

A THREE-BAND COIL

If you are bothered with a multiplicity of plug-in coils for your exciter or portable and don't care to go to band switching, this compromise may solve the problem.

The coil form is made in the time-honored manner using a 7- or 8-prong octal base from one of the "G" series of tubes. The coil is wound for the lowest-frequency band desired and tapped for the two next higher-frequency bands. The plug and socket are wired as shown in Fig. 311. The socket must have two keyways cut in it, one between pins 1 and 2 and one between pins 2 and 3. This can be done with a small hacksaw blade or file. To change bands, merely pull out the coil and plug it in another keyway. Unused turns are automatically shorted.

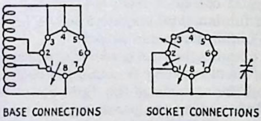


Fig. 311 — Diagram of the base and socket connections for the three-band plug-in coil.

Should the base have insufficient length for the necessary winding, a section of tubing of the correct diameter may be cemented over the base. — *Arlo Sullivan, W7CMY.*

—•••—

NEUTRALIZING R.F. STAGES WITH A MODULATION MONITOR

While changing bands in the old rig, I always tuned the buffer stages with the final plate power off and, in so doing, I noticed the modulation monitor's carrier-level meter showing a reading. After a little thought I realized I had a very sensitive neutralizing indicator.

With this method I reneutralized all the r.f. stages and was surprised at the amount of neutralization that was necessary to eliminate all the r.f. in the various tank circuits.

For a high degree of accuracy, the monitor can be rather tightly coupled as the tubes become more perfectly neutralized. Also, the percentage-of-modulation indicator will register any audio frequency that might be introduced in the various stages by hum or feed-back.

Try it sometime and see if your stages are perfectly neutralized. — *Phillip F. Jones, Jr., W4FWD.*

—···—

PARALLEL FEED IN GRID AND PLATE CIRCUITS

W4AYE suggests the use of parallel feed in both grid and plate circuits to remove d.c. voltages from the neutralizing condenser. The neutralizing condenser is connected to the side of the voltage-blocking condenser opposite that to which the grid is connected as shown in Fig. 312.

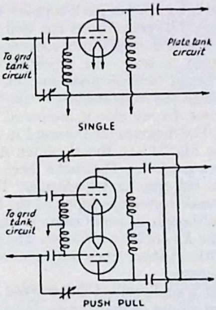


Fig. 312 — **Circuits showing that it is feasible to remove d.c. voltages from the neutralizing condensers by using parallel feed in both grid and plate circuits.**

The same idea may be applied to capacity-coupled systems, provided parallel feed is used in the preceding-stage plate circuit. The blocking condensers may have any capacity from about 100 μμfd. upward.

—···—

NEED MORE NEUTRALIZING CAPACITY?

The capacity and the breakdown voltage of a neutralizing condenser may be increased by insertion of high-dielectric material between the plates. Two somewhat similar methods for doing this have been suggested by contributors, and are given below.

"The range of those neutralizing condensers which lack sufficient capacity to neutralize 203-A and 212-D tubes may be increased by insertion of ⅛-inch bakelite sheet between the plates," writes Will A. Bell, W6JXS. "The bakelite should be cemented securely to one of the plate surfaces to insure that all effective areas be parallel. The condenser air gap (distance between surface of the bakelite and the metal surface opposite) ordinarily should be approximately 1/16 inch. Other dielectric materials may be used, but consideration of the dielectric constant and power factor should be used in their selection."

Erwin Aymar, Tegucigalpa, Honduras, C. A., provides the following additional note on this same topic:

"To raise both the maximum capacity and the breakdown voltage of a transmitter neutralizing condenser, such as one of the National NC series, it is only necessary to place a piece of window glass on the lower plate. The glass should be cut so as to extend a quarter of an inch or so beyond the edge of the plate to prevent flash-over."

A table of breakdown voltages and dielectric constants of other suitable insulating materials is given on page 458 of *The Radio Amateur's Handbook*, 1945 edition.

—···—

SUBHARMONICS

Class-C oscillators with fixed bias are unstable. Decreasing the feed-back below a certain level results in a sudden cessation of oscillation. This trait is sometimes troublesome, but may be useful for certain purposes.

Occasionally a subharmonic of a given frequency is desired. It is possible to "lock" an oscillator near one of its harmonics, if the oscillator has a stable frequency. Control of such a condition is, however, uncertain.

If the negative fixed bias is increased until oscillation ceases, then a high frequency applied to any of the electrodes of the oscillator tube will renew oscillation at a subharmonic of the exciting frequency.

Strong feed-back gives good output but requires a large negative bias and a high excitation voltage. These conditions are necessary for fool-proof operation when the ratio of frequency division is as high as one to ten. — *2nd Lt. Herbert Brooks, ex-W9SDG.*

—···—

SIMPLE TREATMENT FOR B.C.I.

Interference to local b.c. receivers may be eliminated easily by connecting a series-tuned wave trap from the second-detector grid to ground. This does not affect the tuning appreciably at any frequency nor the sensitivity of the receiver.

In case the set uses diode rectification, the trap may be connected across the last intermediate plate or grid to ground, but be sure the condenser will not break down under the normal plate voltage or you may have a set to replace.

Antenna wave traps have been useless in most of my cases, but this really is effective. — *Ellery Plotts, Chicago, Ill.*

Note. — This will hold true only if the capacity is sufficiently small to produce appreciable reactance at broadcast frequencies. The capacity should be no larger than that which will permit retuning of the circuit with the trimmer condenser. Somewhat larger capacities will be permissible for the 3.5- and 1.75-Mc. bands. — Editor.

ON ELIMINATING B.C.L. INTERFERENCE

After spending a lot of dough on equipment and putting in a lot of time building the rig, I found that I had key clicks, blanketing, and feed-back into the power lines. Otherwise the ole rig worked swell!

First of all, I started to work on the feed-back which was helping to blanket the b.c.l. receivers in the neighborhood. Fig. 313-A is the hook-up I used. The coil is wound on a large General Radio ceramic form, and the wire size is No. 12. This coil had enough impedance to act as a choke and it stopped the feed-back. To make this a good job and be sure that no r.f. was getting past the choke, I grounded the "ground" side of the power line close to the transmitter and by-passed the hot side to ground. This did surprising things in helping to get rid of a lot of blanketing.

With the feed-back now gone, the blanketing came next. After a little search, I found in the *Handbook* data on some low-pass filter systems. Perhaps this was just the thing I was looking for! So I built one just to see if the durn thing worked and — lo and behold — it did! The diagram and coil data are given in Fig. 313-B. I might add that the filter system must be designed for the lowest frequency used. If you are working on 160, the filter system must be designed for complete cut-off at 1600 kc. The one shown in the diagram for this purpose is recommended for working in several bands.

Now for the key clicks which were really doing some damage. I used two types of filters, but the second one was the one that did the best work for me. In Fig. 313-C is the one I tried first. That helped, but it just didn't come up to what I thought it should. The second was simpler, and really worked the best for me. I use block-grid keying and a b.c. power pack supplies the necessary voltage. The transformer is a Bell telephone transformer which came out of a connection box. The variable resistor was adjusted until the oscillator began to draw plate current, or rather adjusted until the highest-biased tube started to draw current. In my case it happened to be the oscillator. The diagram for the one I'm now using is shown in Fig. 313-D. But the filter of Fig. 301-C really is a good one. The choke there is the primary of a bell-ringing transformer. The 0.006-μfd. condenser across the input of the filter may be tried, although in some cases it may not be needed. The *Xs* are for r.f. chokes. The filter may be built without them since they are needed only in extreme cases.

The stuff I've described has worked very well for me, and would probably give someone else a galloping start toward getting his troubles ironed out. — *Eugene L. Fegley, W8MPB.*

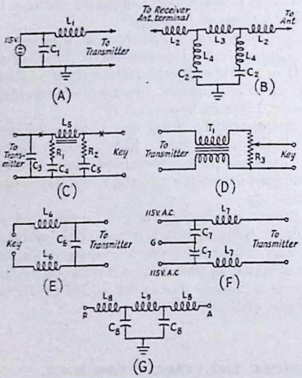


Fig. 313 — (A) a simple line filter designed to prevent feeding r.f. from the transmitter back into the power lines. (B) a low-pass r.f. filter to be inserted in series with the antenna of the b.c. receiver. It eliminates the necessity of tuning a wave-trap. (C) and (D) two types of lag circuits for eliminating key clicks. (E) a key-click filter of the r.f. type. (F) another power line filter. (G) a simple low-pass r.f. filter for the b. c. receiver.

C_1 — 0.25-μfd. paper.
C_2 — 25-$\mu\mu$fd. mica.
C_3 — 0.006-μfd. mica.
C_4, C_5 — 0.5-μfd. paper.
C_6 — 0.01- to 0.05-μfd. paper.
C_7 — 0.1-μfd. paper.
C_8 — 500-$\mu\mu$fd. paper.
R_1 — 100 ohms, 1-watt.
R_2 — 100 ohms, 1-watt.
R_3 — 500–25,000-ohm wire-wound potentiometer.
L_1 — See text.
L_2 — 18 turns No. 28 d.s.c. 1⅜ inch diameter.
L_3 — 29 turns No. 28 d.s.c. 1⅜ inch diameter.
L_4 — 24 turns No. 28 d.s.c. 1⅜ inch diameter.
L_5 — Primary winding of bell-ringing transformer.
L_6 — 2.5 millihenry r.f. chokes.
L_7 — 180 turns No. 12 enamelled, 1¼ inch diameter.
L_8 — 33 turns No. 24 d.s.c. 1⅝ inch diameter.
L_9 — 54 turns No. 24 d.s.c. 1⅝ inch diameter.

—···—

CURING NOISE FROM THE TRANSMITTER

I have just finished clearing up a source of noise which might be of interest to others. I had first thought the mercury-vapor rectifiers to be responsible, but a check showed that the source of noise was somewhere else. I purchased two new filter condensers on the assumption that they might be leaking. These condensers were installed and the supply turned on without being connected to the transmitter. No noise appeared in either the communications receiver or the broadcast receiver. However, on connecting the supply to the transmitter, this machine-gunning again started, this time at a more rapid speed and much louder than before.

I started with the tubes and removed parts from the final amplifier. After removing tank coil, grid coil, r.f. choke and by-pass condenser, I removed the leads from the final-amplifier plate meter. At this time the noise stopped. I removed the meter from the panel and opened the case. I found that the shunt consisted of a short length of about No. 20 resistance wire, the only irregularity being that two turns of the wire were touching. The insulation on this wire is single cotton and was burned brown. I moved the turns of wire apart and reinstalled the meter. The interference completely disappeared.

It appears that there may have been some leakage across this point, but this leakage was not sufficient to cause any variation in the plate current reading of the meter. This might possibly be a good suggestion for others who are experiencing similar trouble. It shows that the mercury-vapor tubes are not always to blame. — *J. P. Gilliam, W9SVH.*

* * *

CURING FILAMENT HUM

Hum in the receiver caused by leaving transmitter filaments connected during reception is a common complaint. The only sure cure seems to be that of opening the grid circuit in the transmitter during receiving periods. A method for doing this automatically, suggested by Robert Berler, W2EPC, is shown in Fig. 314. W2EPC writes as follows:

"A three-watt neon lamp was purchased and its base was removed by heating over a flame. The internal wire resistor was removed from the base of the lamp and then the base was replaced. The 'C' bias lead to the final amplifier is broken at the cold side of the r.f. choke and the lamp is connected in series at that point. The neon lamp can safely pass 65 milliamperes, but if more current is drawn it is advisable to connect two lamps in parallel."

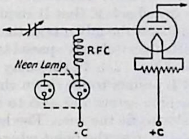


Fig. 314 — Using a neon lamp in the grid circuit for curing hum from the transmitter during reception. A 3-watt lamp with the base resistor removed is required. In a stage where heavy grid current is drawn, two or more lamps should be connected in parallel.

* * *

KINKS FOR PORTABLE TRANSMITTERS

Here are a couple of suggestions which may be of interest.

The first suggestion is that of using flashlight lamp bulbs as resonance indicators in low-power rigs where either cost or space eliminates meters. On my portable I placed lamps in series with the tank tuning condensers and they worked out well with no noticeable bad effects, even though I was afraid one in the oscillator tank would cause poor keying. A 6N7 is used as a v.f.o. and doubler-buffer. With a plate voltage of 300 volts, 2.5-volt lamps light to about three-fourths full brilliance at resonance.

Mounting the lamp sockets right on the tank condensers helps to keep leads short.

In order to eliminate the grief caused by microphone batteries being either run down or forgotten, it was decided to eliminate them. It was reasoned that, since the modulated amplifier plate load was constant, microphone voltage could be taken from the drop across the cathode resistor. In this case a pair of 807s was used. A 100-ohm wire-wound resistor was installed as indicated in Fig. 315. A variable resistor was used to accommodate various single-button microphones, and checks on an oscilloscope and on the air have indicated operation to be just as satisfactory as with dry batteries.

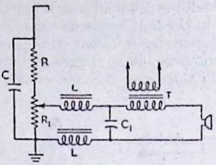


Fig. 315 — Circuit used to eliminate the microphone battery in a portable 'phone transmitter.

C_1 — 25-μfd. 50-volt electrolytic.
R, C — Usual values of cathode resistor and by-pass condenser.
R_1 — 100-ohm 25-watt wire-wound.
L — W. E. Co. 46-N retardation coil. (Small 2-winding chokes, 100 ohms per coil. Almost any small iron-core chokes may be used, such as old high-resistance doorbell or buzzer coils.)
T — Usual microphone transformer.

If the original cathode resistor is of the slider type, and only one microphone is to be used, the 100-ohm variable resistor may be eliminated. In either event, adjust the tap or slider for correct button voltage at no signal input and final running at normal rating. The filter was required to eliminate motor-boating. While I do not recommend its universal use, the idea does provide a very satisfactory substitute for batteries in a portable where high-fidelity operation is skipped in favor of simplicity.

The combination of the two ideas described above contributes to the cause in more ways than one, as you can see. Extra and unattached parts are easily forgotten, broken or a dozen other things when you grab the portable for a hurry-up day afield. — *Herb Walleze, W8BQ.*

* * *

SIMPLIFIED I.C.W. OPERATION

For i.c.w. operation I simply connect a conventional high-frequency buzzer in series with the microphone winding. Even though the resistance of the microphone winding is a few hundred ohms, I have had no trouble in getting the buzzer to key well with only 2 or 3 volts. A 4.5-volt "C" battery works best. The audio output is very high with this arrangement. Reports on the performance have been very complimentary. Only a few parts are required for this system and the audio-frequency tone can be varied over a wide range. — *Michael A. Ziniuk, W8PZL.*

NON-SHORT-CIRCUITING COIL CLIPS

A very simple and effective clip is shown in Fig. 316-A. This idea was submitted by W2-HNX. It may be made by folding a strip of phosphor bronze or similar material and forming the end around a nail or drill of suitable size. Similar clips are obtainable from certain manufacturers of transmitter coils.

To prevent the clip from twisting far enough to short-circuit turns, a hole is drilled about halfway up the clip and a small rod of insulating material such as bakelite or celluloid from a knitting needle is inserted in the hole and cemented fast.

At (B) a somewhat different arrangement utilizing the same principle is suggested by VE4AJQ. The clip, in this case, is made of two pieces of heavy spring brass or phosphor bronze bent at right angles, formed at the ends, and fastened with machine screws to a strip of insulating material.

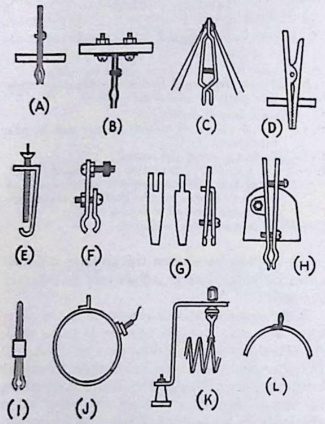


Fig. 316 — Non-short-circuiting types of coil clips.

W8QPS uses a "pee-wee" clip of the "bulldog" type with the jaws filed down to permit use on coils with closely spaced turns. The clip is fitted with celluloid strips as shown at (C) to prevent tipping too far. The same idea was suggested by W8OWL.

Along the same line is the "alligator"-type clip, shown at (D). Each jaw is fitted with a peg of insulating material. This design was submitted by Harold W. Hartman of Los Angeles.

Three types of "pressure" clips are shown at (E), (F), and (G). In each case, sufficiently firm clamping is possible to prevent the clip from turning and short-circuiting turns, even with a strong pull. The design shown at (E) was submitted by K4EDS. The metal piece is ¼ to ⅜ inch wide. The hole at the top is tapped to accommodate the flat-head machine screw. A small piece of sheet metal is soldered in the screwdriver slot to form a wing-screw which may be turned by hand. Two simple types which require the use of a screwdriver are shown at (F) and (G).

The first suggestion was submitted by W2DC and the second method, which is designed to prevent any possible twisting while tightening, was suggested by W2BXJ.

In case anyone feels that he must have absolute insurance against twisting, the design at (H) by W9SZN should fill the bill. The metal pieces should be cut from stiff brass of as great thickness as practicable. An "ear" is cut as shown on one of the pieces to permit fastening to the small piece of insulation which effectively prevents tipping. The bottom screw should not be tightened completely as it is only a sort of pivot. The clamping action is obtained chiefly by means of the upper screw.

A rather novel clip is suggested by W6GFK and is shown at (I). The clip itself is first formed from a piece of spring brass. A narrow band of soft brass then is bent around the upper part of the clip. Sliding this band up and down on the clip will loosen or tighten the clamping.

Another highly satisfactory tapping arrangement is shown at (J). This idea was suggested by W4PL and E. Ottney, Peterboro, Ontario. Its most serious drawback is that it requires soldering, although it has the advantage that it may be used with coils of very closely spaced turns. While an ear or tab of No. 12 or 14 wire may be used for the tap, W4PL prefers to file down the head of a No. 6–32 machine screw and also to file out the screwdriver slot to fit the wire. The head then is soldered to the wire at the point where the tap is desired. A standard 'phone tip is just the right size to take a 6–32 tap, so the tip may be threaded onto the screw. If a tap is not available, the threads of the screw may be filed off until the 'phone tip may be slid on over the screw and soldered in place. Contact to the tap is made by means of a standard 'phone jack which also will fit on the No. 12 or 14 wire.

Still another scheme is shown at (K). This idea comes from W2GSI. A contact from a small knife-switch, properly formed to fit the wire, is fitted to a standard Eby binding post. This post has a hole passing through the shaft which will pass No. 12 wire. The clip may be slid along the wire to the desired point and tightened by the clamping action of the binding post. The wire support, which also serves as the lead to the tap, holds the clip at right angles to the axis of the coil.

A clever tapped coil is shown at (L). An ordinary small soldering lug is soldered to the wire and then almost any type of clip will provide good contact with little danger of its falling over on adjacent turns. The wire may be fastened on with a machine screw. If taps must be made on every turn, the lugs may be staggered. This idea comes from W8NDV.

Editor's Note. — In making the clips shown above, or in constructing any other type of adjustable clip for coils, it is important that no ferrous metal be used. Phosphor bronze, copper or spring brass fittings are required.

MOUNTING TRIMMER CONDENSERS

When rebuilding my rig I decided to mount the grid tuning condensers inside the coil forms (link-coupled circuits) to save space. To eliminate loose wires inside the coils I ran across this very helpful kink which saves plenty of time and trouble.

Instead of using the usual four- or five-prong coil form, I purchased the six-prong type (some of which have a mounting shoulder for mica or air trimmers). Hook the twisted pair for the link to the large terminals, and the ends of the grid coil winding to plate and cathode prongs. This leaves the two top prongs free for connection to the tuning condenser. The connections may be pulled tight and cut off, as indicated in Fig. 317. This permits easy removal or installation of the tuning condenser. Connections between the condenser and the two sides of the grid coil are made on the socket. Don't forget these! — *R. N. Eubank, W3WS - W3AAJ.*

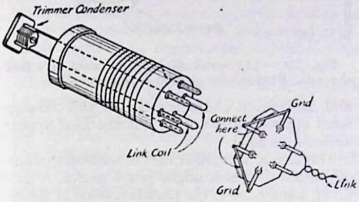


Fig. 317 — **Wiring arrangement for easy removal of a trimmer condenser mounted in a coil form.**

SUPPORT FLANGES FOR HOLDING STANDARD RACK UNITS

A recent visit to a military station disclosed a handy gadget to facilitate mounting and removal for replacement or servicing of single units in standard-rack installations. Two simple flanges, as shown in Fig. 318, are permanently attached to the rack, either by flat-headed screws or rivets or by welding them on. These provide surfaces for holding a chassis or cabinet, which is slid onto or off the flanges, without the necessity of holding the unit in place while panel screws are being inserted and tightened. Thus one man can install heavy equipment which would otherwise require the aid of another.

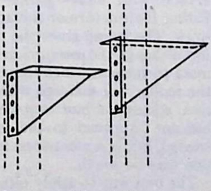


Fig. 318 — **Simple flanges attached to a standard rack make for easier handling of heavy units.**

The flanges are of very simple design and any ham could make them up from scrap sheet metal. If it is desirable to avoid any projection of the flange supports on the front of the rack, they may be mounted behind the front edge of the channel or attached at the rear of the rack members by drilling the necessary holes. — *W1CBD.*

A HOMEMADE NEUTRALIZING CONDENSER

In building my new rig I needed neutralizing condensers for my 809 buffer and HF100 final. Not wanting to wait too long for delivery, I made a dive into the junk box and came up with enough odds and ends to make a pair of very acceptable substitutes for the commercial product.

A sketch of one of the condensers is shown in Fig. 319. It is patterned after the well-known coaxial cylinder type. The cylinders are cut from defunct electrolytic condensers. The inner one is one inch in diameter and was taken from a 4-μfd. condenser, while the outer one, taken from an 8-μfd. unit, is 1⅜ inches in diameter. For a maximum capacity of 10 μμfd., the cylinders should be approximately 2 inches long. For the same diameters, other maximum capacities will be proportional to the length of the cylinders.

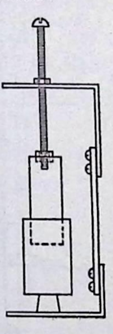


Fig. 319 — **Neutralizing condenser made from old filter condenser cans by W8VTC.**

Care should be taken to drill the hole for the adjusting screw for the movable cylinder at the exact center and to mount the stationary cylinder centrally in respect to the movable cylinder. The air-gap should be sufficient to prevent breakdown when used in a plate-modulated amplifier operating at plate voltages up to 1500.

Pieces of metal strip are used to mount each cylinder. The upper strip is tapped to fit the long machine screw used for adjusting the capacity. The two metal portions are insulated by a strip of insulating material, such as polystyrene. — *Samuel A. Balaban, W2KVA-W8VTC.*

PREVENTING VOLTAGE BREAKDOWN IN 6L6 OSCILLATORS

Here is a method for preventing arcing in 6L6 tubes, and thus saving power supply components. Trouble was experienced with a 6L6 operating with 400 volts on the plate, indicating that the power supply was being shorted within the tube itself. Since the operation was normal (the tube was used as a tetrode crystal oscillator with medium load), an arc within the elements was considered highly improbable. Therefore, the connection between the *shell* and *ground* was removed, and this was found to remove the shorting load. Since the point of lowest breakdown voltage in this type of tube seems to be between connections for the elements and the shell, use of a 0.01-μfd. 600-volt condenser between metal shield pin No. 1 and ground is recommended. — *Edwin F. Ehlinger, W8BBP.*

—···—

A SIMPLE BAND-CHANGE SWITCH

An easily constructed and inexpensive switch of the coil-shorting type, devised by J. Stanley Brown, W3EHE, is shown in Fig. 320. The contacts are bronze fuse clips, the shorting contact a length of quarter-inch brass rod. The parts should be mounted on good high-frequency insulating material such as Victron (which is easily worked) to prevent power loss.

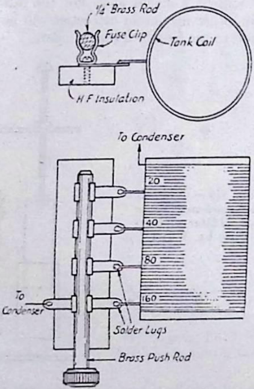


Fig. 320 — An easily constructed home-constructed shorting-type switch for band-changing.

A switch of this type has high current-carrying capacity, low electrostatic capacity between contacts, and permits laying out the circuit so that the shorting leads have negligible length.

—···—

STAND-OFF INSULATOR KINKS

Recently we were faced with the problem of getting some feed-through insulators quickly and cheaply. Since we had none on hand but did have several ordinary 2¼-inch stand-off insulators, we rigged up a very satisfactory substitute by boring a ¾-inch hole through the chassis and bolting the stand-off insulator in place, as shown in Fig. 321-A. Not only are the electrical and mechanical characteristics of this arrangement entirely satisfactory, but the final appearance also is good.

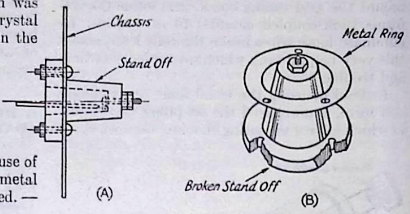


Fig. 321 — (A) stand-off insulator used as a feed-through. (B) repair for circular-base stand-offs.

This brings up another idea in relation to stand-off insulators which might prove useful. A good many hams have in the junk box some of the old circular-base insulators with three-hole mounting. Since the base is very fragile, they usually have one or more of the mounting holes chipped away. We have found that we can use stand-offs of this type which have two or even three mounting holes gone, by cutting a metal ring of the same diameter as the base and placing the ring over the stand-off before bolting it, as shown in Fig. 321-B. — *Dale Scarbrough, W6UCM, and Laverne Hixson, W6TZY.*

—···—

A METHOD FOR LOWERING CRYSTAL FREQUENCY

I'd like to pass on a suggestion I have hit upon regarding crystals. It applies to one of those little tragedies so common in the life of the ham who grinds his own crystals. I mean those crystals which have been pushed a kilocycle or two too far and are irretrievably past either the desired frequency, or perhaps, the band edge. Various means have been tried to bring them back. I think the best one is still the expedient of having them silvered, but this process is quite a chore, whereas the stunt I will suggest takes but a moment and works equally well.

Briefly, the idea is to paint the surface of the crystal with either iodine or mercurochrome. Either the tincture or the aqueous solutions will work. The iodine gives the most pronounced effect although the mercurochrome will probably be more permanent, since there is a possibility that the iodine will undergo what is called sublimation, somewhat like evaporation. Thus far this has not happened to the several rocks I have treated, but it is mentioned for what the observation may be worth.

The best way to apply either treatment is first to clean the crystal thoroughly in soap and water, then rinse thoroughly in warm clean water. Next, lay the crystal flat on a level surface and, placing one drop of either solution in the center of the surface, guide it around over the crystal face until the whole surface is covered. Let it dry and then repeat the job on the other side. The effect may be increased, up to a certain limit, by repeating the treatment two or three times. Before replacing the crystal in the holder, it should be wiped with a very soft cloth, or a piece of lens tissue, to remove any particles of lint or dust which might have settled on it.

This treatment usually will move a 3.5-Mc. crystal three or four kilocycles. I moved one 7-Mc. AT-cut crystal nearly thirteen kilocycles. Instead of impairing the crystals, as do most of the hit-or-miss treatments such as India ink, this one seems actually to improve the activity of the crystal up to a certain point.

I don't recommend this stunt as a substitute for proper grinding but, as an emergency measure, it is well worth while, particularly for the fellow who has a good frequency-measuring device. I've managed to get several of the boys around here to try it out and they all report good results. Except for silvering, it is the only thing I've ever found that will do any good. — *B. P. Hansen, W9KNZ.*

—…—

A COMPACT MULTIPLE CRYSTAL HOLDER

I HAVE just completed a simple and compact multiple crystal holder. A sketch is shown in Fig. 322. *B* is a strip of metal, preferably brass, $\frac{3}{16}$ or $\frac{1}{4}$ inch thick, 1 inch wide and 6 inches long. The strip forms a common plate for one side of all crystals and the surface should be made as flat as possible. The individual top plates, *A*, are made from pieces of brass angle stock. The surfaces next to the crystals also are ground flat. These pieces are mounted on a sheet of bakelite, or preferably polystyrene, 3 inches wide and 6 inches long. The mounting holes are filed or drilled-out to form a slot so that the positions of the top plates are adjustable. Holes for the 6-32 mounting screws are tapped in the base.

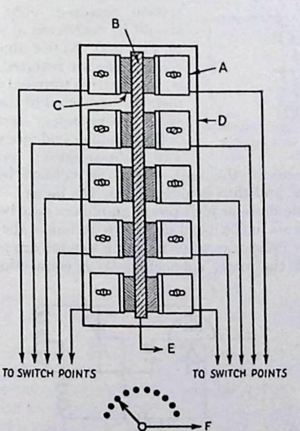


Fig. 322 — **A compact multiple crystal holder. *A* indicates the individual adjustable top plates. *B* is the contact plate common to all crystals. *C* indicates the crystals. *E* and *F* are external connections to the circuit.**

It is not necessary that the common central bar be fastened to the base. Before installing the crystals, loosen all the mounting screws and pull the two end pairs up tight against the bar and tighten the mounting screws. Then tighten-up the remaining pairs in like manner. Each top-plate then may be loosened up individually while inserting the crystal.

The unit is wired up as shown in the sketch, soldering the top-plate connections directly to the plates. The whole thing may be built for a few cents and will take up very little space in a crystal oven. — *Ronald Patrie, W9CWD.*

—…—

AN INEXPENSIVE CRYSTAL SELECTOR SWITCH

ALTHOUGH there are several types of crystal-selector switches on the market, they are relatively expensive. The simple switch assembly described here can be constructed easily from spare parts on hand in the average amateur station. The materials required are:

10 General Radio type jacks (see note below).
1 single-gang 6-point switch (Yaxley No. 6263).
1 $\frac{3}{16}$-inch bakelite strip $1\frac{1}{2} \times 5\frac{1}{2}$ inches.

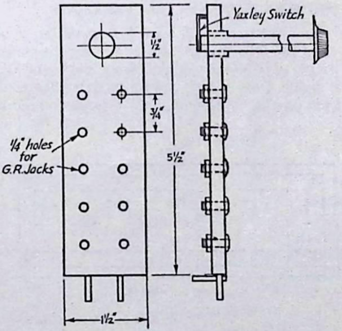


Fig. 323 — **An easily constructed plug-in base and selector switch arrangement for crystal switching.**

(EDITOR'S NOTE. — These jacks will fit the standard pin plugs used on the plug-in type of crystal holder. If a round-type crystal holder is used which plugs into the standard 5-prong tube socket, tube-pin type jacks should be used.)

The jacks are assembled on the bakelite strip as shown in Fig. 323 so that the crystal holders will plug in horizontally (flat). The distance between adjacent levels of jacks will depend on the thickness of the crystal holders used. The ¾-inch separation shown in Fig. 323 is based on the thickness of the regular rectangular type of crystal holder.

All leads should be kept as short as possible, especially the wire going to the crystal oscillator tube's grid, in order to minimize the distributed capacity.

If your present transmitter is already equipped with a five-prong socket mounting for the crystal holder, this crystal selector switch can be arranged to plug into the socket by adding a 1 × 1-inch bakelite strip, equipped with two tube pins for plugging into the socket. This small bakelite strip is attached to the bottom of the switch mounting by means of two small brass angle brackets.

The crystal selector switch described above was used at W2PF-WLNA for over a year and a half without any trouble. It was indispensable in changing almost instantaneously from the special Army Amateur 3497.5-kc. frequency to the 3510-kc. amateur frequency and back again, which was often required during AARS drills or in handling traffic. Adjustments of tank condensers usually are not required for frequency shifts not exceeding 20 kc. — *David Talley, W2PF.*

—···—

PLUG-IN CHASSIS CONNECTIONS

While rebuilding my transmitter, I devised the following method of making the chassis connections to the cabinet wiring and found that it made quite a neat-appearing job. The plugs used on the chassis are similar to plugs used on coil forms and are mounted on a strip of bakelite which is set over a section of the back of the chassis which has been cut out. The plugs on the bakelite base then fit into plug sockets mounted on bakelite in the back of the cabinet. The wiring to these plug sockets can be cabled or put in pipe according to the desire of the builder. The general idea is shown in Fig. 324.

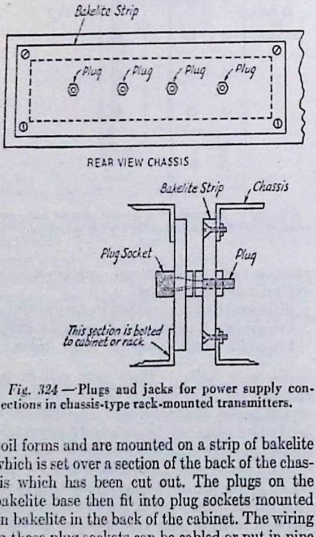


Fig. 324 — Plugs and jacks for power supply connections in chassis-type rack-mounted transmitters.

This proves a quick method for removing the chassis from cabinet or rack for inspection or repair. — *Charles F. Yung, W2GAU.*

—···—

A THREE-WAY CRYSTAL SOCKET

Here is a simple idea that may save other amateurs much trouble in finding out why their crystals do not oscillate, only to discover that the crystal was plugged in the wrong way when using the regular two-point connection.

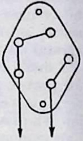


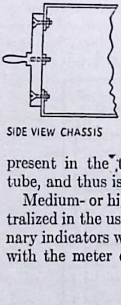
Fig. 325 — When the crystal socket is wired in this manner, correct connections will be made whether the crystal is inserted in any of the three possible ways.

By wiring the conventional five-prong socket as shown in Fig. 325, the crystal will be properly connected in the circuit regardless of how it is plugged into the socket. — *D. H. Fowler, W1ACV.*

—···—

USING A VOLTMETER AS A SENSITIVE NEUTRALIZING INDICATOR

A voltmeter makes an excellent indicator of perfect neutralization. It is considerably more sensitive than the usual indicators such as neon bulbs, flashlight bulbs and grid current meters. The meter used should have a range of several hundred volts and should be connected as shown in Fig. 326. Notice that the connections are reversed; that is, the positive terminal of the meter is connected to the negative power-supply terminal of the amplifier and vice versa. The radio-frequency current present in the tank circuit is rectified by the tube, and thus is indicated by the meter.



Medium- or high-power amplifiers may be neutralized in the usual manner with one of the ordinary indicators while finishing touches are put on with the meter connected. With connections to

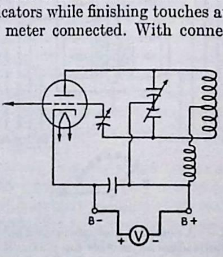


Fig. 326 — How a d.c. voltmeter may be connected to serve as a sensitive neutralizing indicator.

the power supply removed, the neutralizing condenser should be adjusted for minimum voltmeter reading. With low-power amplifiers the whole process can be done with the voltmeter.

In our amplifier it was found that the voltmeter would register several volts even when the grid meter showed that the amplifier was perfectly neutralized, and even a fraction of a turn of a "micrometer"-type condenser would make a very noticeable change in the voltmeter reading. This permits very accurate neutralization of even flea-power rigs, which themselves prove to be a problem in this respect. — *Donald Clark, W1MJU.*

* * *

KINKS FOR REDUCING HAZARDS IN NEUTRALIZING

In most of the articles on safety which have appeared in past issues of *QST* the point of removing all voltages before working on the transmitter has been stressed. Although it is possible to neutralize an amplifier by removing all voltages, making an adjustment of the neutralizing condenser, applying excitation, checking grid current while tuning the plate tank circuit through resonance and repeating the process until stationary grid current is obtained, this method is rather laborious and additional check by the neon-bulb method is often desirable. Neon-bulb tests with plate voltage applied are often helpful in determining the presence and nature of parasitic oscillations.

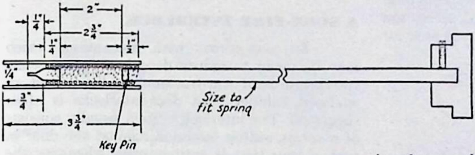


Fig. 327 — Homemade insulated flexible screwdriver designed for adjusting neutralizing condensers safely.

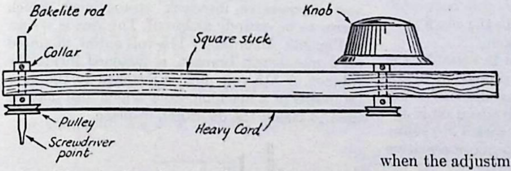


Fig. 328 — Another simple gadget which may be used for adjusting neutralizing condensers with safety.

In following the usual practice of holding the neon bulb against the tank coil with one hand while adjusting the neutralizing condenser with a screwdriver held in the other, the hazard is not so great from the tank circuit itself, since the plate voltage is removed from the amplifier being neutralized, but there is always the danger of the hands coming in contact with live circuits of the exciter or its power supply.

Robert Murray suggests the insulated flexible screwdriver, illustrated in Fig. 327, for adjusting neutralizing condensers from a safe distance, after a screwdriver slot has been cut in the end of the shaft of the neutralizing condenser. A length of brass rod is filed to a screwdriver-edge at one end, and the other end is soldered to a length of coil spring. The other end of the spring is fastened to a length of hard rubber or bakelite rod fitted with a standard knob as the handle. A piece of rubber tubing, cemented over the screwdriver tip and the spring, serves as a locator guide. The screwdriver may be bent at any angle so that it may be used regardless of whether the neutralizing-condenser shaft is running vertically or horizontally.

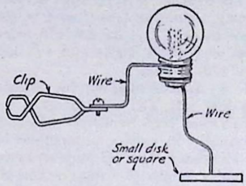


Fig. 329 — The danger of holding a neon bulb in the hand when making neutralizing adjustments can be avoided by clipping it on one end of the tank coil. The small plate compensates for the usual hand capacity.

Mr. Murray suggests mounting the neon bulb on a battery clip by means of a few turns of heavy wire wound about the shell of the base, so that it may be clipped on the end of the tank coil or plate terminal of the tube, making it unnecessary to hold the neon bulb in the hand. This may work successfully if the neon bulb is near the chassis but, in some cases, it may be necessary to attach a small metal plate to the central terminal of the bulb. This plate, shown in Fig. 329, should be connected by means of a length of rather heavy wire which may be bent so that the metal plate is near, but not touching, the chassis. This will provide enough capacity to ignite the bulb even when the adjustment is near the point of neutralization.

Another remote-control screwdriver idea is shown in Fig. 328. It consists of a light stick of wood, or other insulating material, with a pulley

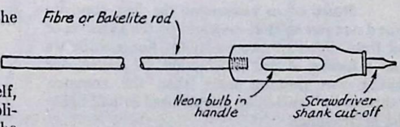


Fig. 330 — Combination insulated screwdriver with neon-bulb indicator in the handle. Such screwdrivers may be purchased at auto supply or hardware stores.

mounted on a shaft at each end. The two pulleys are connected with a heavy cord belt. The shaft at one end is ground down to a screwdriver-edge and the other shaft is fitted with a knob. The pulleys may be of the type found in toy constructional outfits. The gadget will work with horizontal or vertical shafts and will keep the hands well out of danger.

Dr. R. J. Kasper suggests the arrangement shown in Fig. 330. The screwdriver is the type which has a neon bulb built into the handle and used frequently in testing automobile ignition systems. The shank is cut off short and ground to an edge and a length of insulating rod is fitted into a hole drilled in the end of the handle. To use this idea, the shaft of the neutralizing condenser always must be connected toward the plate circuit of the tube.

NEUTRALIZING THE AMPLIFIER WITH SAFETY

Fig. 331 shows an arrangement I have been using successfully for some time in neutralizing amplifiers equipped with link output coupling. A flashlight bulb is simply connected across the link and the neutralizing condensers adjusted for no indication, or minimum indication. This system has the advantages over the neon-bulb method that it does not unbalance the circuit and that it is entirely safe in operation.

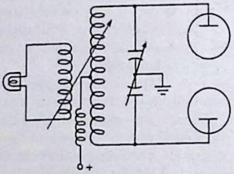


Fig. 331 — **W8RBL uses a flashlight bulb connected to variable link for safe neutralizing.**

If coupling to the output coil is variable, the most sensitive bulb available should be used, starting with very loose coupling and increasing the coupling as the point of neutralization is approached. With fixed links, start with a less sensitive bulb and finish up with the more sensitive one. — *R. E. Span, W8RBL.*

SWITCHING ON OR OFF FROM FOUR LOCATIONS

Some of us remember the first time we wired our rigs so that we could switch them on or off from either of two positions. For a while we had a feeling of real satisfaction. Of course, our wiring was nothing more than the common "three-way" switching circuit used in hall lighting in dwellings.

Many occasions arise when it would be most convenient to be able to switch from more than two positions. The circuit shown in Fig. 332 permits control from four locations and requires only standard switches found in knife, toggle and snap-switch types.

Two single-pole double-throw switches and two double-pole double-throw switches (wired as reversing switches) are needed. Note that in the diagram all switches are shown switched to the right and that the circuit as shown is off. Switching at any of the four positions puts the circuit on. This may be followed by switching to "off" from that or any other of the four positions. — *Charles F. White, USNR, New York, and Robert J. Hearon, Austin, Texas.*

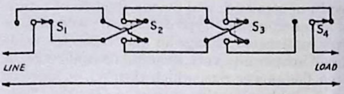


Fig. 332 — **Circuit for controlling a transmitter or other device from any one of four separate positions.**
S_1, S_4 — S.p.d.t. toggle switch.
S_2, S_3 — D.p.d.t. toggle switch.

A SURE-FIRE INTERLOCK

In connection with precautions which may be taken to reduce danger of injury while working around the transmitter, the use of an enclosed cabinet with door-interlocks is often suggested. The interlock system usually consists of a spring switch mounted against the door in such a way that it springs open whenever the door is opened. The switch contacts usually are connected in series with the primary winding of the high-voltage plate transformer or in a relay circuit controlling the transformer primary circuit. While these switches are nearly foolproof there is always the possibility that either switch or relay will stick without opening the circuit.

For some time I have been using a very simple and inexpensive interlock arrangement which seems to be entirely foolproof. The idea is shown in Fig. 333. An ordinary 115-volt outlet, mounted on a metal-strip bracket, is fastened inside the cabinet. A 115-volt plug is fastened to the door by means of a machine screw which also may be used to fasten the doorknob in place.

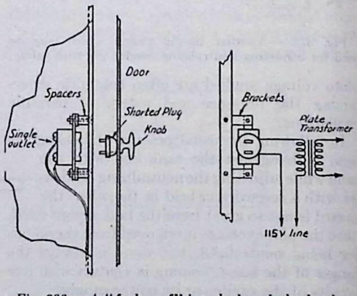


Fig. 333 — **A "foolproof" interlock switch circuit.**

The outlet is connected in series with one side of the 115-volt line and the high-voltage transformer primary and the two prongs of the plug on the door are connected together. Care should be taken to make sure that the nut holding the plug in place does not ground the plug contacts to the door or knob.

It is difficult to conceive of any means by which this system could fail because the circuit is broken manually when the door is opened and no dependence is placed upon springs. The plug and outlet also serve as a door catch. — *Milton Mix, W1IPL.*

……

A NON-CHATTERING OVERLOAD RELAY WITH ELECTRICAL RESET

It is easy to revamp an old battery-charger relay into an overload relay that will cut the final amplifier stage input to low power and hold it there until a front-panel switch is flipped, resetting the relay. Rewind the old relay with enough turns of small wire so that it will throw on less current than your final draws in normal action, then shunt it with a rheostat to enable it to be adjusted to the exact current value at which you want it to go into action. Connect it to your final as shown in the diagram of Fig. 334. *R* is a rheostat, 20 ohms. *B* is 3 volts of flashlight cells. L_1 is a 2.5-volt dial-light bulb in a front-panel pilot-light socket. S_1 is the re-set switch. S_2 is a switch enabling the operator to cut to low power for tuning-up. L_2 is a 115-volt light bulb (200 watts for my rig) to reduce the voltage applied to the high-voltage transformer primary. Both switches are kept closed for normal operation. Adjust contact *X* so that it will make as soon as there is the slightest break of contact *Z*. The purpose of battery *B* is, of course, to further energize the relay coil and hold contact *Z* open until the reset switch is flipped. — *Carl C. Drumeller, W9EHC.*

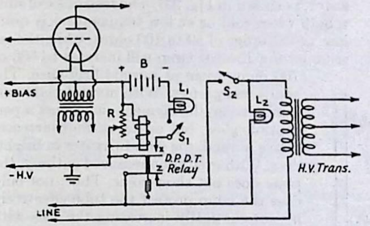


Fig. 334 — Non-chattering overload relay circuit. The relay may be made from a rewound charging relay.

……

METER SWITCHING WITH TOGGLE SWITCHES

Fig. 335 shows various circuit combinations for a simple and safe meter-switching system which requires nothing more than a s.p.d.t. toggle switch to make a single milliammeter serve for checking two circuits.

At (A), the meter and switch are connected so that either grid current or plate current of the same stage may be checked. When the switch is thrown to the left, the meter reads grid current; when thrown to the right, it reads plate current.

The circuit at (B) shows connections for two meters. The first reads grid current of either doubler or final, while the second reads plate current of either stage. As the circuit is shown, both doubler and final tubes may be operated from the same filament transformer, but separate high-voltage supplies are required. In the arrangement at (C), separate filament transformers are required but both stages may be operated from the same plate supply. In each stage, grid return should be made to filament center-tap rather than to ground. It will be noticed that neither the meter nor the switch is at high potential above ground in any of these circuits.

The meter-shunting resistances should be 10 to 25 ohms each if no scale multiplication is desired. If a change in the meter range is desired, when switching from one range to another, the shunting resistances may be adjusted to give the desired multiplication. If the resistance of the meter is known, the shunting resistance required to give the desired multiplication may be calculated by the following formula:

$$R = \frac{R_m}{n-1}$$

where *R* is the shunt resistance, R_m the resistance

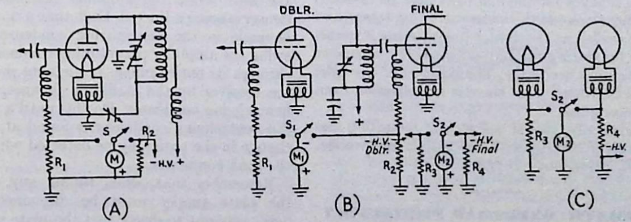


Fig. 335 — Toggle-switch meter switching. (A) circuit for switching meter from grid to plate circuit of same stage. (B) circuit for switching grid meter between two stages and plate meter between two stages. (C) is an alternative circuit, similar to (B), in which separate filament transformers permit the use of a common plate supply. R_1 and R_2 are grid-circuit meter shunt resistors, while R_3 and R_4 are the plate-circuit shunt resistors.

of the meter and n the scale multiplication factor. The required resistance also may be determined experimentally by connecting the meter in series with a low-voltage battery and rheostat and adjusting the rheostat so that the meter reads full scale. Various shunt resistances then may be tried across the meter terminals until a value is found which will cause the meter reading to fall to that fraction of full-scale deflection which is the reciprocal of the multiplication factor desired. The meter reading should fall to $\frac{1}{10}$ for a multiplication of 10, to $\frac{1}{5}$ for a multiplication of 5, to $\frac{1}{2}$ for a multiplication of 2, etc.

In all cases the resistors should be of adequate current rating to prevent any possibility of burning out under heavy overload. In most cases, it will be practicable to make up the multiplying resistors from ordinary copper magnet wire. — *Howard E. Gullberg, W5GGS.*

—···—

ILLUMINATION FOR METERS

FIG. 336 shows the method I use to illuminate meters mounted behind the transmitter panel. A hole is cut in the panel of such a size that the scale of the meter may be seen clearly. The meter is then mounted at an angle by using long spacers on the mounting screws at the bottom of the meter and a short spacer on the top mounting screw. The ends of the spacers should be filed to correspond to angle of tilt.

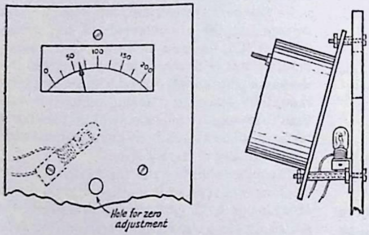


Fig. 336 — A novel method of mounting ordinary meters to obtain indirect illumination. It also removes danger of contact with the zero-adjusting screw when the meter is in a high-voltage circuit.

The bracket for the dial light may be fastened underneath one of the lower mounting screws and a hole drilled at the center for inserting a screwdriver for setting the zero-adjust screw whenever this becomes necessary. The position of the light should be varied until there is no reflection from the meter glass.

Incidentally, this is one way of mounting meters so as to comply with the ARRL safety code. — *J. E. Greenbaum, W1LIG.*

—···—

AUTOMATIC OVERLOAD PROTECTION FOR 807 AND OTHER TUBES

I HAVE been using a trick here at W9BPS with such success that I feel sure that others would be glad to know about it. My rig is a small affair ending up with an 807 in the final. I key the final and use plain grid-leak bias, since I have found that any amount of cathode resistance which will give the tube any adequate degree of protection during adjustments, or in the event of failure of excitation, also limits the power output more than I like.

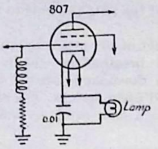


Fig. 337 — Series cathode lamp for automatically protecting an 807 against overload, as used by W9BPS.

However, after losing one 807 and almost losing another, I cast about for some answer to the problem. I finally hit upon the idea of using an ordinary low-power lamp bulb as a cathode resistor, as shown in Fig. 337. The resistance of such a bulb when cold or at low temperature is quite low, of the order of 50 to 100 ohms, while the resistance of a 15-watt lamp will increase to 600 or 700 ohms when at normal brilliance. The result was perfect! With normal plate current flowing, the filament shows just a perceptible glow, but as the current increases above normal, the glow increases in brightness. With excitation removed entirely, the plate does not show color. Thus, not only does the lamp protect the tube effectively by automatically increasing the bias with high plate current, but the lamp gives a visual warning. — *H. A. Fanckboner, W9BPS.*

—···—

RECEIVER AS NEUTRALIZING INDICATOR

DID you ever try to neutralize an amplifier without a neon bulb or any of the other usual indicating instruments? Here is a simple but satisfactory method which requires no equipment other than the station receiver:

Turn on the oscillator only. Tune the receiver to the frequency of the oscillator and listen to the note while the amplifier neutralizing condenser is being adjusted. Each time a small change is made in the neutralizing condenser setting, swing the amplifier plate tuning condenser slowly through its entire range. If the note produced in the receiver by the oscillator changes, reset the neutralizing condenser. Do this until a setting of the neutralizing condenser is found at which no change in the note may be detected while tuning the tank condenser.

Remember that, when tuning any amplifier, the plate supply must be disconnected; but don't attempt to disconnect the plate supply by taking the clip off the top of the tube (if the amplifier tube uses a top-cap plate connection), because this breaks the r.f. circuit.

A TUBE TIME-DELAY CIRCUIT FOR REMOTE TRANSMITTER CONTROL

Fig. 338 is the circuit diagram of a two-wire transmitter control and keying circuit.

Relay Ry_1 is a small four-contact (normally open) single-throw relay, operating on a small current at 6 volts. This relay is operated by the closure of the telegraph key by the operator at the sending position.

When the key is depressed, this relay closes its four contacts, *a*, *b*, *c*, and *d*. Contact *c* closes the circuit from the 115-volt supply line through plate and filament transformer primaries; contact *b* closes the circuit of battery B_1 and the filament of the time-delay tube, placing this tube in operating condition; contact *a* introduces the voltage of battery B_4 to cancel out the cut-off bias of B_3 applied to the time-delay tube, permitting plate current to flow through this tube and thus closing relay Ry_2. Contacts *e* and *f* of Ry_2 short contacts *b* and *c* of Ry_1; and since the resistance and capacity circuit in the grid section of the time-delay tube are designed to maintain Ry_2 closed for a period of 15 seconds after the release of the key, the filament and plate transformers, as well as the filament of the time-delay tube, remain turned on until a pause of fifteen seconds occurs in the transmission. When this length of time has elapsed, relay Ry_2 opens, turning off all power.

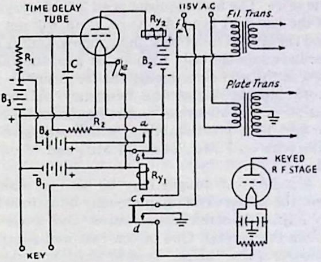


Fig. 338 — Circuit of the vacuum-tube time-delay remote-control system suggested by W8VK.

Starting the transmitter for each transmission is accomplished by holding the key down for about one second which allows time for the tube filament to heat and relay Ry_2 to become operative.

The convenience and certainty of operating without the necessity for pushing buttons or throwing switches will be appreciated by the amateur who has never used such a system, and the practicability of controlling the transmitter from a number of points, remote and local, through paralleling any number of keys, will be well worth the effort expended. — *P. J. Eubanks, W8VK.*

By a slight addition to the circuit, so that 115 volts would be applied to the primary of the plate transformer by contact *f* on relay Ry_2 alone, whereas the primaries of all filament transformers would be closed by both contact *c* and contact *f* as shown, the filaments of the rectifier and transmitting tubes may be heated before application of plate voltage, using the same two-wire system. Furthermore, an indirectly heated cathode tube of the six-volt type may be used for the time-delay circuit, insuring that the filament heating time will be ample. — Editor.

A CONTROL FOR HIGH-POWER RIGS

I found it just about impossible to obtain a relay capable of handling the inductive load of the primaries of the plate transformers in the big rig. Finally I succeeded in picking up a three-phase 5-hp. motor starter of the contactor type, together with the usual push-button control. By adding a small double-pole relay it was possible to provide for push-to-talk operation, as well as control, with a minimum of wiring complications. Provision also was made for the operation of signal lights at the operating position. The circuit is shown in Fig. 339. The system will work on either the three-wire 115–230-volt lines or on single-phase 115-volt circuits. If the rig is operated from the latter, the jumper indicated by the dotted lines should be used.

Referring to the diagram, momentary closing of contacts *A* of S_4 by the starting button closes the circuit to the coil of the relay, *Ry*, causing contacts *D* to short-circuit and starting contacts *A*, and to hold the relay closed through the stopping contacts, *B*. When *Ry* closes, it actuates the power contactor, S_1, through the relay contacts, *E*. When the contacts at *B* are broken by pushing the stopping button half way, the circuit through the relay winding is broken, *Ry* opens, opening the power switch, S_1, and also opening the holding contacts, *D*.

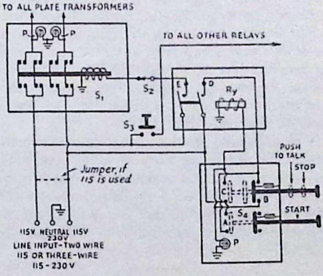


Fig. 339 — Transmitter control for high-power rigs.
P — Warning light.
R_y — Double-pole relay, normally open.
S_1 — 3-phase 5-h.p. contactor-type motor starter.
S_2 — S.p.s.t. toggle switch.
S_3 — Push-button type switch for testing.
S_4 — Push-button type control for S_1.

When the stopping button is pushed all the way in, contacts *C* close the circuit to operate the relay, but since contacts *B* are open, the holding circuit through the relay contacts *D* are open and the holding circuit does not operate. In this manner, the system may be operated for push-to-talk communication.

S_2 is a safety switch located at the transmitter, which, when open, prevents application of the power from the operating position. S_3 is a push-button type switch, also located at the transmitter, for tuning. — *Alvin U. Haugen, W9PRZ.*

—···—

ANOTHER SINGLE-SWITCH CONTROL SYSTEM

In the diagram of Fig. 340 a simple throw of the switch automatically disconnects the transmitting antenna from the receiver and throws it into the transmitter antenna tank system. It also disconnects the receiver for transmitting and throws the transmitter plate voltage transformer into operation. A flip back disconnects the transmitter power and antenna, turns on the receiver, and connects the antenna to the receiver. Thus, a single switch performs all the operations for changing between transmitting and receiving.

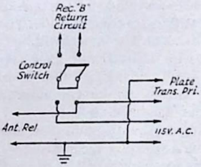


Fig. 340 — W8FAZ's single-switch control system.

For duplex work, the antenna relay must be discarded and a separate antenna introduced to the receiver but, otherwise, the operation remains the same, provided a separate send-receive switch is located on the receiver in parallel with the connections marked "Rec. B."

A double-pole double-throw mercury contact switch will serve the purpose best, especially in the case of a 'phone transmitter, where a silent change-over is desired. A single-pole double-throw antenna relay switch can be used where such arrangements are necessary. — *Joseph Zelle, W8FAZ.*

—···—

A VARIABLE-FREQUENCY CRYSTAL HOLDER

The experience of being told that some other station is transmitting on the same frequency you are, or near enough to heterodyne badly, is of course one of the commonest among amateurs. While the operator of a transmitter which is not crystal controlled may have a certain advantage in being able to shift his frequency at will, few of us wish to sacrifice the advantages of crystal control, especially on the higher frequencies. Having several crystals is of course a help, but quite often a number of them may be tried without finding a satisfactory spot. There is also the likelihood of some other station being unable to find the carrier again after a shift.

The variable-frequency crystal is obviously the answer to this problem, giving the stability of crystal control yet allowing a sufficient shift of frequency to clear other carriers. The frequency change may be made while operating the transmitter, thus allowing the other operator to follow along on the receiver. Any adjustment of the tuned circuits is usually unnecessary.

However, variable frequency crystal assemblies are relatively expensive, and it is the purpose of this discussion to describe how an ordinary holder may be converted into such a unit, or at least how one may be acquired at little more than half the price. The first requisite is an 3.5-Mc. crystal of the low-drift type. An X- or Y-cut will not do, and the crystal must be a "hot" one so that it will oscillate satisfactorily with an air gap, the variation in the gap determining the frequency — the more gap the higher the frequency. A normal variation of 6 kilocycles on the fundamental may be had with good stability, which will give 12 kilocycles on 7 Mc., 24 on 14 Mc., and 48 on 28 Mc.

A number of designs may be used in making over the holder. The top plate may be fastened to an adjusting screw which raises and lowers it above the crystal. One of the best and simplest however is the "hinge" type in which one edge of the top plate is always against the crystal, the opposite edge being raised and lowered to vary the gap. This holds the crystal firmly and allows operation in any position. As a typical case the conversion of a Bliley LD2 unit will be described in detail.

First disassemble the holder, removing the top plate, the two contact plates and crystal, and the coil tension spring. Solder a wire to the center of the bottom plate and insert the end of the wire through the terminal pin, soldering at the tip. This gives a solid bottom contact plate for the crystal. The top contact plate should be prepared by cutting two strips of thin spring brass about ⅛ inch wide and ⅛ inch longer than the width of the plate. These are soldered on to the plate parallel to each other at two corners, the free ends extending the ⅛ inch beyond the opposite edge of the plate. Two small bits are cut away in the inside corners of the bakelite frame so that when the plate is slipped in, the two overlapping strips will hold the one edge up and yet will be sufficiently recessed so as not to be clamped when the top disc is screwed down. There remains but to drill a hole through the circular top plate, thread it to take the adjusting screw and reassemble the unit. If a ¼-inch screw is used, a knob may be put on it. The original calibration of the crystal will of course be changed somewhat and if it is desired to know the exact frequency at various settings it will be necessary to recalibrate. The same frequency will always be found at the same setting of the adjustment.

The air gap will cause a noticeable decrease in crystal current, making for safer operation of the crystal as well. — *L. W. Sorensen, W6JWQ.*

4. *Hints and Kinks . . .* for the 'Phone Rig

'PHONE MONITOR USING INFINITE-IMPEDANCE DETECTOR

George Montgomery, W8IKE, describes a simple 'phone monitor which enjoyed considerable popularity among the hams of Western Pennsylvania. The monitor, shown in Fig. 401, makes use of two triodes, one as an infinite-impedance detector and the other as an audio amplifier. In addition to the feature that the detector will handle high-percentage modulation without distortion, and therefore comes the nearest to telling the operator what his signal sounds like at a distant receiver, the following advantages are claimed:

Wide-range frequency response.
Can be used on any band from 3.9 to 60 Mc.
Single adjustment.
Suitable for use with crystal headphones.

The unit is designed to operate from the receiver power supply. Small by-pass condensers are used in the detector circuit for high fidelity. The resistor, R_3, in the "B" + lead provides additional filtering.

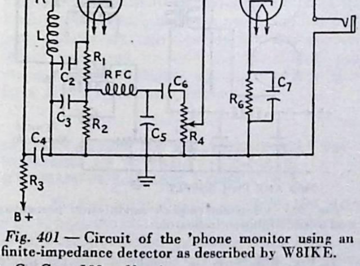


Fig. 401 — Circuit of the 'phone monitor using an infinite-impedance detector as described by W8IKE.

C_1, C_2, C_3 — 100-μμfd. mica.
C_4 — 8-μfd. electrolytic.
C_5 — 50-μμfd. mica.
C_6 — 0.05-μfd. mica.
C_7 — 10-μfd. electrolytic.
C_8 — 0.1-μfd. paper.
R_1 — 50,000 ohms.
R_2 — 0.1 megohm.
R_3 — 10,000 ohms.
R_4 — 0.5-megohm variable.
R_5 — 0.1 megohm.
R_6 — 2000 ohms.
L — 25 turns No. 24 d.c.c., close-wound, 1½-inch diameter.
RFC — 2.5-mh. r.f. choke.

With the audio volume control, R_4, at maximum setting, the length of the pick-up antenna is adjusted to give satisfactory signal strength on the band on which the signal seems to be weakest. When this length has been determined, the volume control is adjusted for signals on the other bands to bring them down to the desired signal strength level.

The same arrangement has been used successfully with dual-triode tubes having separate cathodes, such as the 6C8 or 6F8.

—...—

'SCOPE COUPLING

Coupling a cathode-ray 'scope for r.f. energy from a 'phone rig employing link coupling from the final to antenna or antenna-tuning unit generally means the use of an extra coil. The diagram of Fig. 402 illustrates a simple but effective means of securing the voltage without the necessity of an extra coil, while the coupling may easily be varied to the correct value for any band.

In the diagram, C_1 may be any small condenser, such as a double-spaced 35-μμfd. variable. This condenser is connected to one side of the link coil, which may be any of the numerous types on the market. The other side of the condenser is connected to the *ungrounded* terminal of the vertical deflection plates. The r.f. input may be varied by increasing or decreasing the capacity of the condenser.

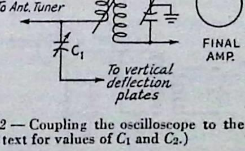


Fig. 402 — Coupling the oscilloscope to the output link. (See text for values of C_1 and C_2.)

With link coupling to an antenna tuner unit, the link may have to be grounded either directly or through a condenser, C_2. This might be of more importance at low power than at higher power. The idea of unbalance may be suggested as a possible disadvantage, but satisfactory operation doesn't require much capacity and any unbalance introduced will be slight. — *George W. Brooks, W1JNO.*

—···—

MODULATION MONITORING WITH AN OSCILLOSCOPE HAVING NO SWEEP CIRCUIT

Fig. 403 shows a simple way to monitor modulation with an oscilloscope which has no linear sweep or amplifier for horizontal displacement. A tuned pick-up coil is connected to one set of plates, while an untuned pick-up coil is connected to the other set. For the tuned unit a midget tuning condenser and tube socket may be placed at the oscilloscope terminals, where the proper coil may be plugged in. The untuned coil has two or three turns placed near the antenna tank so that it will pick up about the same voltage as is developed in the tuned circuit.

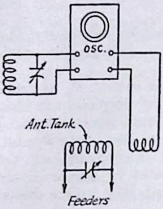


Fig. 403 — Using an oscilloscope without linear sweep circuit for measuring modulation.

When the condenser in the tuned circuit is rotated through resonance, a point will be found where a circular outline will appear on the screen. When modulation occurs this circle will increase and decrease somewhat in size, giving the appearance of a disc with the unmodulated portion of the carrier appearing as a dark spot in the center. A bright spot in the center clearly indicates overmodulation. Distortion will be indicated by circular lines more or less brightly illuminated than the rest of the pattern. — *R. E. Patrie, W9CWD.*

—···—

'PHONE MONITORING KINK

From Caldwell Smith, W5FKW, comes a suggestion for making use of the grid current that usually flows in the first r.f. stage of a receiver during transmitting periods, even though the "B" supply is switched off. W5FKW simply inserts a headset in series with the grid return so that the quality of 'phone transmissions can be checked. One method of doing it is shown in Fig. 404. The 'phones should be removed from the jack or short-circuited by contacts on the "send-receive" switch during reception.

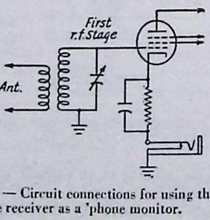


Fig. 404 — Circuit connections for using the first r.f. tube in the receiver as a 'phone monitor.

This arrangement is nothing more than the familiar diode detector, the grid of the first r.f. tube acting as the diode plate. It makes a satisfactory 'phone monitor, and requires nothing more than a jack.

—···—

SIMPLE MODULATION INDICATOR

Those 'phone amateurs using plate modulation and desiring a negative-peak overmodulation indicator will appreciate the gadget diagrammed in Fig. 405. This unit may be set to indicate modulation up to 100 per cent; in other words, to give a warning signal when a peak of a predetermined amplitude exceeding 100 per cent is reached in the modulation.

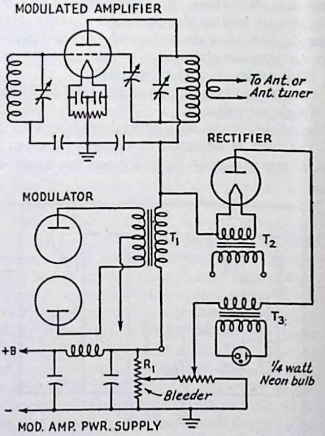


Fig. 405 — A negative-peak modulation percentage and overmodulation indicator.

In Fig. 405, R_1 is the bleeder across the modulated amplifier plate supply, while R_2 is a potentiometer in parallel with the portion of R_1 between ground and the adjustable tap. R_2 serves two purposes — that of a vernier control on the portion of R_1 in use, and that of a convenient method of adjusting from the front of panel the tap from the audio transformer primary for the proper voltage above ground on the modulated amplifier plate-supply. T_3 is an audio transformer with primary connected in series with a rectifier between the modulated amplifier "B" + connection and the adjustable tap on R_2. The polarity of the rectifier tube connections is such that the voltage at the "B" + connection of the amplifier must be negative with respect to the voltage of the R_2 tap to cause a warning flash of the modulation indicator. This indicator, a simple neon bulb with the resistor removed from the base, is shown connected across the secondary of the audio transformer, T_3.

The neon bulb is mounted in an old Readrite meter case with a frosted glass; this makes the small flashes more noticeable. The glass disc may be given a frosted appearance by grinding the surface with a fine abrasive just as crystals are ground to frequency.

If the tap on R_1 is set at a point one-fourth the distance from the ground end, R_2 may be used to set the modulation percentage to give indications at any value between 75 and 100 per cent. However, on many 'phone transmitters the plate voltage used for the modulated amplifier limits this range, for the voltage across R_2 may be as high as 500 volts if the tap on R_1 is set at one-fourth the voltage in a transmitter with 2000-volt supply. Unless a heavy-duty potentiometer or a slider-type resistor mounted on the front of the control panel is used, care must be taken to limit the range of the variable unit to a value safe for the control.

A suitable rectifier for use in this indicator is an 81 tube, with the filament supplied by a 7.5-volt transformer insulated to withstand more than double the plate supply voltage. Although the inverse peak voltage on the rectifier tube will be higher than the rated value, the current through the tube is limited sufficiently so that the overload is not serious.

If the potentiometer or slider resistor used for R_2 is linear (that is, if the resistance between tap and end terminal varies proportionately with angular movement of the tap or rotation of the knob), this control, once the tap on R_1 has been permanently set, may be readily and conveniently calibrated to show the modulation percentage at which flashes will occur. — *Ray Harland, W7FRA, Moscow, Idaho.*

—•••—

ELIMINATION OF FILAMENT TRANSFORMER IN A NEGATIVE-PEAK OVERMODULATION INDICATOR

Use of the modulated-amplifier plate current to heat the filament of the rectifier tube used in an overmodulation indicator of the negative-peak type has been proposed by James Fulleylore, Port Washington, N. Y., and by George Woster, W9FHN. With this simplifying step, the apparatus required for the indicator is reduced to a single rectifier tube of low filament-current requirements and a neon-bulb or meter indicating device. The cost of an expensive filament transformer with high-voltage insulation is eliminated by the use of the amplifier plate current for filament heating.

The circuit shown in Fig. 406 is designed to operate with high-voltage amplifiers as well as with low-voltage high-current stages. Since the tubes suitable for use as rectifiers with the low filament heating current available are not capable of withstanding very high inverse peak voltages, W9FHN places the rectifier filament between series sections of the secondary winding of the modulation transformer. Because this connection of the rectifier makes only a fraction of the audio output voltage available for operation of the modulation indicator, the tap on the resistor across the power supply, R_1, must be placed a proportionate distance toward ground from the positive supply terminal to cause flashes at 100 per cent modulation.

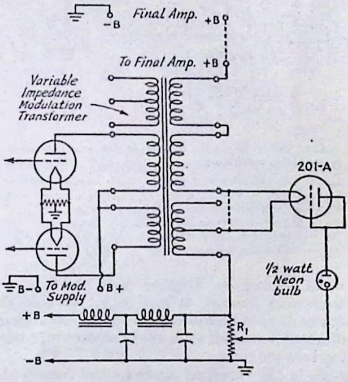


Fig. 406 — Negative-peak overmodulation indicator.

If a modulation transformer with two equal secondary windings designed for series or parallel connection is used, the rectifier filament may be connected in series with the two windings when used for high-voltage modulation. Where the more recent type of variable-match transformers are used, in which separate winding portions are connected in series to form a secondary suitable for matching a desired impedance, the secondary portions should be connected in such a way as to place the rectifier filament only a few turns from the positive power-supply connection.

The voltage divider, R_1, for the d.c. voltage to the indicator is made up of carbon or small wire-wound resistors, with a total resistance (ohms) equal to about 1000 times the power-supply voltage and a total power-dissipation capacity of approximately 5 watts. A simple refinement for this indicating system is the use of a potentiometer as as portion of the voltage divider. When properly calibrated with a borrowed oscilloscope, the potentiometer may be set to flash at any desired modulation percentage.

This system, with the rectifier tube connected at the center of the modulation transformer secondary, has been in use several months at W9FHN on a 1500-volt modulated amplifier, with entirely satisfactory results.

VOICE-CONTROLLED TRANSMITTER SWITCHING

Being a very lazy person, I want to eliminate as much work as possible in the operation of my postwar rig. Here is a system to eliminate all the drudgery of pushing a button or a toggle switch to turn on the transmitter! (There are some other advantages to be pointed out.)

The circuit is shown in Fig. 407. The controlling elements of the device are the two potentiometers, R_1 and R_2. Together with C_2, R_1 is the time-delay control. It can be set to hold the transmitter in operation from zero to a maximum of about 5 seconds after the operator stops talking into the mike.

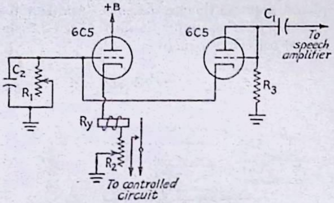


Fig. 407 — Diagram of circuit for voice control of transmitter switching.

C_1 — 0.01-μfd. 600-volt paper.
C_2 — 1-μfd. 200-volt paper.
R_1 — 5-megohm potentiometer.
R_2 — 25,000-ohm potentiometer.
R_3 — 1 megohm, ½-watt.
Ry — 2500-ohm s.p.s.t. relay.

R_2 is the threshold control which allows the operator to adjust the input level to suit his own particular requirements. Experience proves that this control can be set from a point where shouting into the microphone will not turn on the transmitter to another point where the sound of steps in another room will actuate the device. Somewhere between these points a setting will be found where normal speech at a distance of about one inch from the microphone will throw the transmitter into operation.

The original circuit employed two 6C5 triodes, as shown in the diagram. One is used as a rectifier, with grid and plate tied together. The other is used as the control tube. One of the new dual-triode tubes, such as the 6SN7 or the 6SL7, having separate cathode terminals for each section, may be used instead of two separate tubes.

Operation of the circuit is as follows. Audio voltage from the driver stage of the speech amplifier is fed through 0.01-μfd. condenser, C_1, to the plate and grid of the rectifier. Rectified voltage from the cathode of this tube is direct-coupled to the grid of the control tube. Thus the flow of current through this tube and through the relay connected in its cathode circuit is speech-controlled. There is no time lag between the time the first word is spoken and the time the relay closes to start the rig.

Two disadvantages appear in the use of this method of transmitter control. It requires that the speech amplifier as well as the control unit be in continuous operation. Further, if the threshold control is set too high, excessive volume from the loud speaker may operate the device during receiving stand-by periods. If headphones are used the latter disadvantage is removed.

Advantages would seem to equal or outweigh the disadvantages. It makes possible break-in operation comparable to the best c.w. practices. With the high-speed change from transmitting to receiving, operation is as natural and pleasant as with the outlawed "duplex" 'phone operation. The operator who has formed smooth speech habits will not be bothered by the clacking of the relay, but the "Ah — er" operators will be rebuked by interruptions by the relay — a possible aid to reformation!

Properly adjusted, this speech-control circuit will be found very helpful. It will be black magic, or at least a source of wonder, to uninitiated visitors to the shack. If used at both stations in communication it will produce a favorable impression of amateur radiotelephone operation in the minds of some who find it hard to understand why the party at the other end does not come right back in reply to questions and remarks, as in land-wire telephone conversations. — *"Lazee Bones."*

—•••—

SIMPLE MODULATOR FOR PORTABLE WORK

In Fig. 408 is shown the circuit of a simple audio amplifier that I have found very useful as a portable modulator and for general utility work. The idea is not new, since at least one manufacturer has used it in mobile police transmitters. Almost any power supply with an output of from 200 to 300 volts at 75 to 100 ma. may be used. The filtering is not critical and no mike supply is needed. I don't happen to have a picture of the complete unit, but it measures only 3½ inches by 6½ inches by 4 inches high. It was built on a homemade chassis 3½ inches by 6½ inches by ¾ inch deep. One side of each heater is grounded, so that only three connecting wires are needed.

Almost any single-button mike will do, depending on the quality desired. The bias tap may need

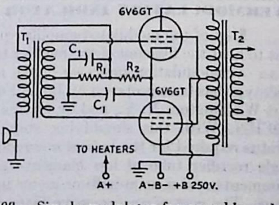


Fig. 408 — Simple modulator for portable and general-utility work used by W7FRA.

C_1 — 10-μfd. 25-volt electrolytic.
R_1 — 100 ohms, 1-watt.
R_2 — 150 ohms, 1-watt.
T_1 —Input transformer (Thordarson T-83A78).
T_2 — Output transformer (Thordarson T-19M13).

to be adjusted to suit the mike and output required. R_1 and R_2 could well be a single resistor with a variable tap. If only a speaker is to be used, the output transformer could be changed. This amplifier, with 275 volts on the plates, will modulate a 25-watt final (input) up to 100 per cent. — *Ray Harland, W7FRA.*

—•••—

SELF-BIASING SYSTEM FOR CLASS-B MODULATORS

It is well known that biasing systems which introduce resistance in the d.c. grid circuit of a Class-B modulator should be avoided because the variable grid current of the Class-B stage will cause a change in bias over the audio cycle, resulting in nonlinearity. For this reason, a regulated supply or battery supply is universally recommended for Class-B applications.

It is possible, however, to filter out the variations in biasing voltage caused by the changing current through a biasing resistor. Fig. 409 shows a circuit which is used frequently in commercial practice. The biasing voltage for the modulator is obtained from a variable tap on a resistor connected between filament center tap and the negative high-voltage terminal. A low-pass filter is connected in series with the biasing lead to the Class-B stage.

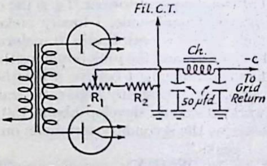


Fig. 409 — Self-biasing system for Class-B modulators. The low-pass filter in the grid lead holds the biasing voltage constant with change in cathode current. The filter is made up of an ordinary low-current choke and a pair of 50-μfd. electrolytic condensers.

The resistance required may be computed by Ohm's Law; it is necessary to know the total current flowing in the center tap and the desired biasing voltage. It is desirable to have a protective minimum bias, which can be provided by making part of the center-tap resistance fixed. By using a fixed resistance of 100 ohms in series with a 150-ohm variable resistor, the resulting bias (at a center-tap current of 225 ma.) would be variable between 22.5 and 56.25 volts.

This system permits panel control of the bias on the Class-B stage and allows adjustment to be made of the idling plate current of the modulator. — *Merle B. Parten, W8BWC.*

—•••—

DIODE MODULATION INDICATOR

Fig. 410 shows the circuit diagram of a modulation indicator which was popular among the boys of the "Farmer's Net." With the switch thrown to the right, the carrier level is indicated on the meter. By means of the variable resistor, R_1, the reading may be varied to suit the operator; I set mine at 0.8 ma. Once set, the point will remain the same. By a flip of the switch the meter is returned to zero with carrier on, but if there is any noise or hum on the carrier the needle will lift off zero in proportion to the amount of noise. (Some of the net boys thought this the best feature.) With the meter at zero with carrier, modulation will show by a lift of the needle. Modulation at a level of 100 per cent will make the needle go to the point of the original setting (0.8 ma., in my case). If this reading is exceeded, overmodulation is indicated.

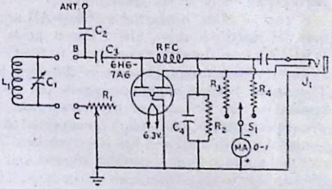


Fig. 410 — Circuit diagram of the dual-diode modulation indicator.

A — Antenna (about 2 feet long; see text).
C_1, L_1 — Tuned to band (see text).
C_2 — 100-μμfd. mica.
C_3 — 50-μμfd. mica.
C_4 — 0.001-μfd. mica.
C_5 — 0.1-μfd. paper.
R_1 — 10,000-ohm volume control.
R_2, R_3 — 50,000 ohms.
R_4 — 150,000 ohms.
RFC — 2.5-mh. r.f. choke.
J_1 — Closed-circuit jack.
S_1 — S.p.d.t. toggle switch.

With the meter in plain sight on the operating desk, any transmitter failure is instantly spotted by watching the indicator. By inserting headphones in the jack the gadget becomes a very excellent monitor.

The transmitter is not disturbed in any way when the monitor is used. It may be used without the tuned circuit by simply shorting the terminals intended for the tuned circuit and attaching the antenna lead directly to the transmitting-antenna feeder. I used mine that way on all bands without any tuned circuit and found that it did not bother the antenna circuit. An alternative would be to connect the input terminals to a line coupled closely to the final-amplifier tank. If the tuned circuit is used, the indicator may be placed anywhere in the operating room and will give fine results with the short pick-up antenna.

When used with the tuned circuit, the unit also makes a good field-strength or antenna adjustment indicator.

Coil and condenser combinations will be found in *The Radio Amateur's Handbook*. Plug-in coils with a small tuning condenser mounted inside the coil-form may be preset to the desired transmitter frequency, for quick band-change.

I mounted mine in a 6-inch-cube standard steel box, and arranged it so that the indicator is turned on with the transmitter filaments.

Credit for the circuit should go to W1BZR and W1HSV. — *George W. Bailey, W1KH.*

AUDIO PEAK LIMITER FOR SPEECH AMPLIFIERS

Automatic volume compression as a means of preventing overmodulation in 'phone transmitters has been advocated in a number of articles in recent issues of *QST*. A rather simple and easily installed system, involving operation only over a single stage, is shown in Fig. 411. It was worked out by M. C. Bartlett, W9JHY, and has proved to be quite satisfactory in practice, since overmodulation is practically impossible once the operating conditions are set. There is no perceptible effect on the speech quality.

A pair of 802s, operating as Class-AB amplifiers, is used to drive the Class-B grids. In W9JHY's case the driver is coupled to the Class-B input transformer through a 200-ohm line. The audio voltage appearing across the line is applied to the primary of the transformer, T_2, whose center-tapped secondary is connected to the plates of a 6H6 used as a full-wave rectifier. The rectified audio voltage is suitably filtered and applied as bias to the suppressors of the 802s. Thus the greater the output signal the greater the bias developed, and, in turn, the lower the amplification in the 802 stage. The 6H6 cathode is given some initial bias through R_6, so that the automatic control does not function until the signal reaches a predetermined level.

In describing the adjustment of the circuit, W9JHY writes:

"Adjust R_2 until the two tubes draw 60 ma. (no signal), which gives about Class-AB operating conditions.

"Now, with constant tone input, measure the voltage appearing from suppressor to ground. This should be about 1 volt, on a high resistance voltmeter, when the Class-C stage is being modulated from 75 to 80 per cent. Then, when the lag of the R_4C_6 circuit is taken into account, the transmitter will not go over 90 to 95 per cent modulation. The setting of R_6 controls the threshold bias on the 6H6, which, if being fed a high enough voltage by T_2, will nicely control the gain of the 802s.

"As an indicator of modulation percentage, or rather of the operation of the compression circuit, a voltmeter (0–100 volts d.c.) can be connected from suppressor to ground — although this will make the gain-change more rapid and tend to upset the C_5R_4 ratio, which must be right. Perhaps a variable resistor at R_4 might be a good idea. It is desirable to set the gain control at some point where the compression is *not* brought into play (since, after all, this system is only intended as a protective measure), and probably better quality will result if no compression voltage appears on the suppressor.

"If this plan is employed where the 802s are driving the Class-B stage grids directly, it stands to reason that the higher voltage which appears at the Class-B grids will necessitate a higher threshold voltage, obtainable with a potentiometer of a proportionately higher resistance at R_6. With voltages of this value, an 80 rectifier could be used to advantage in place of the 6H6.

"The coupling transformer, T_2, is the only part that proved troublesome. I finally picked on an old high-ratio General Radio transformer that had bumped around the junk box since the days of two-filament audions. I believe it is either 6:1 or 10:1 ratio, but almost any high-ratio transformer will work; it should develop about 150 volts of audio across the secondary terminals on external peaks."

In W9JHY's speech amplifier, the 802s replaced a pair of 2A3s formerly used in the driver stage.

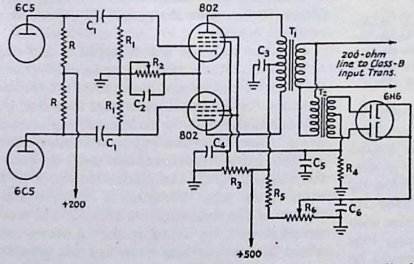


Fig. 411 — Amplitude limiting circuit for pentode speech amplifiers.

C_1 — 0.1-μfd. paper.
C_2 — 1.0-μfd. paper.
C_3 — 4-μfd. electrolytic.
C_4 — 1.0-μfd. electrolytic.
C_5, C_6 — 0.1-μfd. paper (C_6 optional).
R — 250,000 ohms, 1-watt.
R_1 — 500,000 ohms, 1-watt.
R_2 — 1000-ohm variable.
R_3 — 40,000 ohms, 25-watt semi-variable.
R_4 — 0.1 to 1.0 megohm (time-constant control).
R_5 — 150,000 ohms, 2-watt.
R_6 — 5000-ohm potentiometer.
T_1 — Class-AB to line transformer.
T_2 — Class-B input or push-pull interstage transformer, 3:1 ratio or higher.

—···—

SHIELDING THE MICROPHONE PLUG

A common cause of r.f. feed-back in 'phone transmitters is inadequate shielding of the microphone circuit. If a manufactured shielded microphone plug is not available, an excellent substitute may be made from an ordinary bakelite-shell plug. These plugs may be shielded easily in the following manner:

For shielding material, use a small piece of tinfoil taken from an old paper condenser. Do not detach the tinfoil from the waxed paper; instead, cut both paper and foil to size so that, when formed in a cylindrical shape, a snug fit inside the bakelite shell of the plug will result. When forming the cylinder make sure that the paper will be turned to the inside, so that there will be no chance of the foil shorting the microphone connections. When the bakelite is screwed back on the plug the thread will bite into the foil, thus grounding it and making the shielding effective. — *W. B. Thompson, W8OKC.*

5. *Hints and Kinks . . .*

for the Power Supply

BIAS SUPPLY FOR R.F. AMPLIFIERS

A SIMPLE and effective scheme for obtaining fixed bias for r.f. amplifier stages is suggested by W8OAH, Edward Eggebrecht, Grand Rapids, Mich. One arrangement, shown in Fig. 501, makes use of a filament transformer with filament winding connected to the filament of one of the amplifier stages. The filament winding, or usual secondary winding, thus becomes the primary of a step-up transformer, giving approximately 115 volts at the terminals of the transformer usually used for primary connection. Thus, when the filament of the amplifier tube is heated, bias voltage is developed across the filter condenser, C_1, and the combination bleeder and grid leak resistor, *R*, by means of the reversed filament transformer and the rectifier.

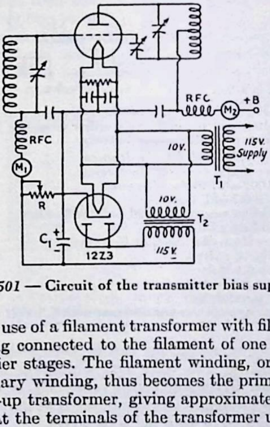


Fig. 501 — **Circuit of the transmitter bias supply.**

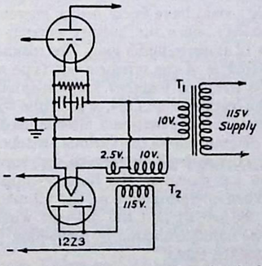


Fig. 502 — **Alternative connections for the bias-supply rectifier system suggested by W8OAH.**

With plate voltage applied and key closed, the grid current flowing through *R* produces the greater part of the bias voltage for the amplifier; whereas, with no excitation applied, the rectifier-filament circuit maintains cut-off bias voltage on the amplifier grid.

It will be noted in the diagram that the cathode connection of the rectifier tube is placed at ground potential, thus preventing a possible voltage breakdown between cathode and heater of the rectifier.

The filter condenser, C_1, should have a capacity of from 8 to 16 μfd. (the latter value being preferable) and a voltage rating of from 450 to 600 volts, depending on the bias voltage which accompanies flow of grid current through the grid leak, *R*.

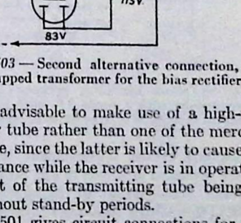


Fig. 503 — **Second alternative connection, using a center-tapped transformer for the bias rectifier.**

It is advisable to make use of a high-vacuum rectifier tube rather than one of the mercury-vapor type, since the latter is likely to cause a slight disturbance while the receiver is in operation, the filament of the transmitting tube being heated throughout stand-by periods.

Fig. 501 gives circuit connections for use of a 10- to 12-volt heater tube as the bias rectifier. An 83V may be used with dropping resistor of 1⅔ ohms connected in series with the heater, or a 12Z3 may be used. (If the 12Z3 is used, a single plate connection is necessary, this being a half-wave rectifier). Although this latter provision does not place the rated voltage on the heater, 10 volts has been found sufficient for the very light duty imposed on the tube by a grid-leak resistor, *R*, of reasonable size.

Figs. 502 and 503 give alternative connections for rectifier tubes and filament transformers, the filter and bias connections with these arrangements being the same as those used in Fig. 501. The three diagrams given are for use with 10-volt tubes; however, similar simple arrangements for use with tubes of other filament-voltage ratings may be easily worked out.

Fig. 502 gives a circuit by means of which a 12-volt rectifier tube may be operated at its full heater voltage, if a spare transformer designed for 2.5- and 10-volt filaments is available.

Fig. 503 shows an arrangement using a center-tapped 10-volt transformer to supply bias voltage through a 5-volt transformer connected to half of the filament transformer secondary. The other half of the filament winding of T_1 is used to heat the 83V or similar rectifier tube.

—…—

IMPROVED VOLTAGE REGULATION WITH VR-TYPE TUBES

During the course of making measurements of small intensities and variations in light with a photoelectric cell and vacuum-tube amplifier, Harry Dubofsky, W1IJP, encountered the necessity for a voltage supply of exceptionally good regulation for the amplifier. He reports some interesting observations in connection with the use of VR gaseous regulator tubes.

The original supply was of good design with a choke-input filter. A single VR150 was connected at the output of the supply in the conventional manner shown in Fig. 504-A. The use of the VR tube resulted in an improvement in voltage regulation of the order of seven to eight times.

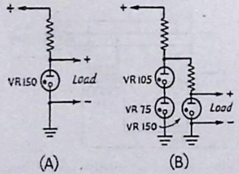


Fig. 504 — Voltage regulating circuits. (A) is the usual arrangement with a single VR tube. (B) is the cascaded form used by W1IJP to improve regulation.

Desiring still greater improvement, three VR tubes were arranged as shown in Fig. 504-B. This arrangement resulted in an improvement in regulation of three times, meaning a total improvement of more than twenty times over the regulation of the supply without the regulator tubes.

Such a combination should be of value in supplies for heterodyne frequency meters and other laboratory oscillators as well as in conjunction with variable-frequency oscillators for transmitters and other applications requiring a high degree of voltage regulation.

A POWER SUPPLY FOR BATTERY OR A.C. USE

From time to time, various experimenters have suggested the use of a b.c. type transformer in conjunction with Ford coils to secure 350 volts or so for the operation of a receiver or portable transmitter from a 6-volt storage battery. An arrangement which strikes us as being a highly practical one is suggested by James McBride, W4BAF, whose supply can be used either on 6 volts d.c. or 115 volts a.c., whichever may be available. In the interests of reliability, W4BAF's rig uses a standard vibrator of the type universally incorporated in auto radio receivers.

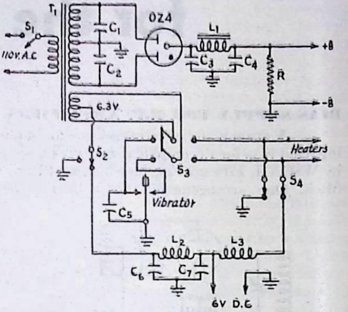


Fig. 505 — Power supply for a receiver or a low-power transmitter which will operate either from the 115-volt a.c. line or a 6-volt storage battery.

C_1, C_2 — 0.002-μfd. 1000-volt mica.
C_3, C_4 — 8-μfd. 450-volt electrolytic.
C_5 — 0.002-μfd. 1000-volt mica.
C_6, C_7 — 0.5-μfd. paper.
R — Bleeder resistor, 25,000 to 50,000 ohms.
L_1 — 30-henry filter choke.
L_2, L_3 — Hash-filter chokes (see text).
S_1 — S.p.s.t. switch.
S_2 — S.p.d.t. switch.
S_3 — D.p.d.t. switch.
S_4 — D.p.s.t. switch.
T — B.c.-type power transformer with 6.3-volt winding

The circuit diagram of the power supply is given in Fig. 505. The transformer is a standard b.c. job, with a 6.3-volt winding which is used as the primary with 6-volt battery supply. This winding should have fairly heavy current-carrying capacity, since the battery current runs as high as 12 amperes under load. The vibrator used by W4BAF is of the synchronous type with the contacts strapped together for non-synchronous use. The rectifier is an OZ4, a gas tube without a hot cathode. A conventional filter is used.

The diagram shows the various switches necessary to change from battery to a.c. supply. All switches are shown in the battery-supply position. When operating on a.c., the vibrator is cut out of the circuit and the 6.3-volt winding resumes its normal function of furnishing filament power for the tubes.

Coils L_2 and L_3 are part of a filter intended to cut out "hash" from the vibrator. They are probably subject to some experimenting to obtain best suppression of noise, but coils consisting of 20 or so turns of No. 12 wire, wound to 1-inch diameter, are suggested.

W4BAF's power supply delivers 90 milliamperes at 350 volts with either a.c. or battery source. It has proved to be highly effective in operating a 6C6-41 receiver and a 6L6 transmitter, both portable and at home.

—…—

A FILAMENT TRANSFORMER KINK

Here is a kink which may come in useful in an emergency. Sometimes a ham has a filament transformer delivering 5 volts or some other voltage and has need for one delivering 6.3 volts. A simple solution is to take a small core and wind an autotransformer on it, the autotransformer to operate from the 5-volt transformer (or whatever the available voltage happens to be).

The diagram of the autotransformer is shown in Fig. 506-A. Make the 5-volt section about 3 turns per volt and then add more turns, tapping off at about every two turns.

The idea has the merit of extreme simplicity, since few turns are required and no particular attention has to be paid to insulation. An autotransformer can be wound in a few minutes. The wire should be of sufficient size to carry the required current and the amount of power drawn from the autotransformer should not exceed the output rating of the transformer from which it is operating.

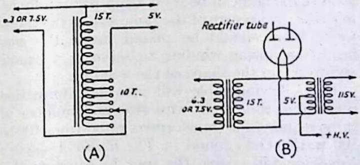


Fig. 506 — **Details of the simple transformers suggested by N8FU. At (A) is shown the autotransformer. (B) is the isolating transformer.**

Another variation of this idea is shown in Fig. 506-B in which a handwound transformer is designed to operate from the filament transformer supplying a rectifier. Isolation between rectifier and other filaments thus is obtained. Here the insulation must be sufficient to withstand the voltage at which the rectifier is operating and the rectifier transformer must have a rating capable of handling the extra power drawn from the homemade transformer. — *J. C. Nelson, N8FU.*

—…—

BOOSTING TRANSFORMER VOLTAGE

In the past few years, probably thousands of a certain make of transformer have been sold at a very reasonable price. The rating is 600 volts, 200 ma. and the transformer has 7.5-, 5- and 2.5-volt windings. Tubes such as the T20, 809, etc., need a bit higher voltage, so I have used a simple scheme to raise the voltage. It means using separate filament transformers for the tubes but these are cheap or easily made. The idea is to connect the 5- and 7.5-volt windings in series to give 12.5 volts which may be added to the primary voltage by connecting them in series with the line as shown in Fig. 507. The three windings must be polarized correctly to obtain this increase. Perhaps the easiest way to do this is to feed 5 volts or so from a separate transformer into the primary winding. This will enable the secondary voltage to be read on an ordinary 150-volt a.c. meter. Then try different combinations of the 5-volt, 7.5-volt and primary windings until the highest secondary voltage is obtained. I am using my transformer in this manner with a pair of 866 jr. tubes and with condenser-input filter get 700 volts at 200 ma. with no heating of the transformer. The increase in output voltage obtained by also using the 2.5-volt winding is hardly worth while. — *Noble Smith, W9HCO.*

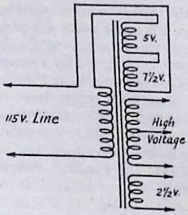


Fig. 507 — **Making use of unused filament-tra former windings to boost the plate-supply voltage.**

—…—

CONNECTING DISSIMILAR PLATE TRANSFORMERS IN SERIES

Roy Wheadon, W6KTY, suggests the circuit shown in Fig. 508 to solve the problem of connecting unlike transformers in series to obtain higher plate voltage. When identical transformers are connected in series, no problem is involved,

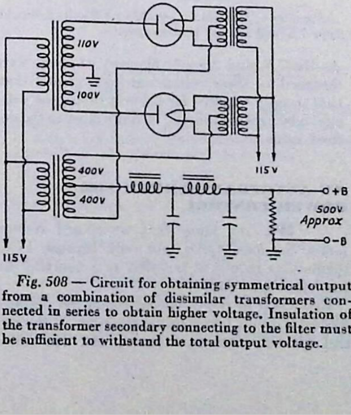


Fig. 508 — **Circuit for obtaining symmetrical output from a combination of dissimilar transformers connected in series to obtain higher voltage. Insulation of the transformer secondary connecting to the filter must be sufficient to withstand the total output voltage.**

since a center tap is obtained easily at the junction of the two identical secondaries. When dissimilar transformers are used, a center tap is impossible and the only means of using such a combination has been by use of the bridge-rectifier system which requires no center tap but does require four rectifier elements.

In the system suggested by W6KTY only two rectifier elements are required, but each filament must be insulated from the other. Double rectifiers, like the type 83, may be used by connecting plates in parallel and using a separate tube for each element shown in the circuit diagram. Balanced output is obtained by connecting one of the transformer secondaries in the rectifier return leads and using both center taps. As with any series arrangement, the transformer on the positive side must have sufficient insulation to take care of the additional voltage. Correct polarization of the primary windings will be required. This can be determined by trial. Incorrect polarization will result in bucking voltages.

—···—

6.3 VOLTS FROM 7.5-VOLT AND 2.5-VOLT WINDINGS

The use of a center-tapped 2.5-volt winding and a 7.5-volt winding to obtain 6.3 volts for heater-type tubes is suggested by Edwin Kirchhuber, W2KJY, Brooklyn, N. Y.

Fig. 509 shows the circuit suggested. The voltage between center-tap and one side of the 2.5-volt winding is connected in phase-opposition with the 7.5-volt winding, and the series combination is used to supply the heater voltage required.

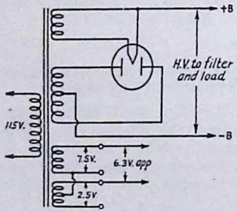


Fig. 509 — Method for obtaining 6.3 volts from old-type 7.5- and 2.5-volt transformers.

As the 7.5- and 2.5-volt filament windings were designed for these voltages at loads greater than that usually required for 6.3-volt tubes, the voltage to be expected should be quite close to the desired value.

—···—

AN AUTOTRANSFORMER FOR POWER CONTROL

We all know that we should reduce power for local QSOs, not only because FCC regulations require it but also as a courtesy to our fellow amateurs.

Reduction in power output should be accomplished without lowering the efficiency of the rig and without retuning, detuning, etc. The well-known, but little-used autotransformer, shown in Fig. 510, serves as a dandy gadget for this purpose and has many other uses around the shack, such as filament-voltage or soldering-iron heat control. Its use provides reduction of power during tuning-up, and may save a tube.

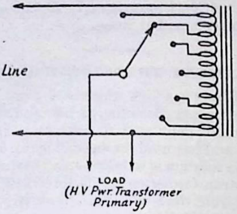


Fig. 510 — Circuit diagram of the autotransformer.

Don't become alarmed over the difficulty of winding a transformer. It is a simple job even without a coilwinder, as the wire is comparatively large and the number of turns relatively few.

Most junk boxes will provide a burned-out transformer having a suitable core. Usually the insulation next to the core will be found to be in good shape and can be used again if carefully removed. A wood core of the same size as the transformer core should be placed inside the core insulation during winding to serve as a handle and to retain the shape of the winding.

The following table will provide information concerning core area, wire size and number of turns required for transformers rated from 100 to 500 watts. Data found in *The Radio Amateur's Handbook* will enable the user to compute this information for higher ratings.

Watts	*Core (Square Inches)*	*Wire Size*	*No. of Turns*
100	2	21	450
200	3	17	300
300	4	15	225
400	5	14	175
500	6	13	150

The job will be simplified if the taps are taken off at the end of each winding layer. In the absence of better insulation, ordinary wrapping paper, doubled, can be used between layers.

Care should be taken to prevent shorting of the windings by contact with the sides of the core. Most cores have room for several windings in the original transformer so that there is no need to crowd the layers close to the core sides.

When the winding is completed, the wooden block is removed and the core carefully fitted back in its place. After assembly and testing are finished, it is well to take the transformer to a shop where armatures are rewound, for dipping and baking. The charge is generally small (mine cost 25 cents). This treatment will waterproof the windings and take the noise out of the core.

The autotransformer may be built into a box with a panel for the switch and outlets. In addition to the switch, tip jacks may be connected to the taps, and jumpers used to connect them to outlets furnishing different simultaneous voltages.

The box should be well ventilated, or the autotransformer should be mounted in the open. However, a well-constructed job should not heat appreciably under rated loads. — *Victor I. Brock, W9TUJ.*

—•••—

AN IMPROVED AUTOTRANSFORMER

A SUGGESTION is offered which may be considered an improvement on the design for a standard autotransformer.

It will be observed that the usual transformer must be designed to carry the total current consumption of the applied load whereas with the design shown in Fig. 511 the power-handling capacity required is only sufficient to withstand the desired difference in line voltage. As an example, assume a line voltage of 120 in which a reduction to 110 volts is desired. In the usual transformer, the total core, diameter of winding, and number of turns must provide a total inductance and current-carrying capacity to satisfy the requirements of the 120-volt primary source, and it must be capable of delivering 110 volts at the current rating demanded by the load.

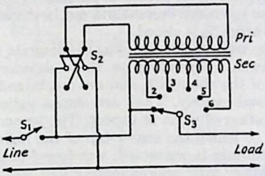


Fig. 511 — Circuit of improved autotransformer.
S_1 — S.p.s.t. toggle switch.
S_2 — D.p.d.t. toggle switch.
S_3 — Multipoint rotary selector switch, single gang.

In the suggested design, the secondary, tapped for various voltages, must supply only the difference between the voltage requirements. In the case of a 120-volt line, reduction to 110 volts would require a transformer capable of supplying only 10 volts at the load-current rating.

By placing a switch in the primary of this autotransformer it is made equally useful for raising voltage as well as lowering it, by shifting the polarity of the primary connection of the transformer to the supply line.

The secondary must have a wire size capable of carrying the current demanded by the load, but in most cases a suitable transformer can be made by winding a tapped secondary of No. 12 soft-drawn copper wire over the windings of a large-size receiver power transformer. Such a transformer when wound with the proper number of turns will either increase or decrease the line voltage, depending on whether the secondary is bucking the line voltage or adding to it.

When the transformer is used in a voltage-bucking position it has a tendency to stabilize line-voltage variation inasmuch as a drop in line voltage will be reflected back to the primary of the transformer. This will, in turn, lower the voltage in the secondary, resulting in a lessening of the bucking effect on the load side. Yet the ratio of voltage correction will still depend upon the secondary output voltage of the transformer. With a line voltage of 120 and a secondary bucking voltage of 60, the load side of the transformer would have only one-half the voltage variation of the primary. In other words, the voltage regulating ability of the transformer is inversely proportional to the primary/secondary ratio of the transformer.

It should be noted that the effect just described is reversed when the transformer is used with the secondary voltage additive to the line voltage.

The writer's transformer is assembled within an old radio-analyzer case to give it portability. It is constructed with a selector switch on the panel. The points of the switch are given dual markings, i.e., the point marked 105–125 is the one at which, with a normal line voltage of 115 volts, the output of the transformer will be 105 volts on the low or bucking side, and 125 on the high or additive side, depending on the position of the primary-reversing switch. — *Jack R. Zeckman, W7DVK.*

—•••—

USING TRANSFORMERS WITH 2.5-VOLT WINDINGS FOR 6.3-VOLT TUBES

Now that there is a trend toward using any old parts that can be salvaged, I would like to pass on an idea for using obsolete b.c. power transformers with 2.5-volt filament windings for tubes with 6-volt heaters.

By replacing the usual 80 rectifier with a tube using an indirectly heated cathode, such as an 84 or 6X5, the 5-volt winding can be connected to one half of the 2.5-volt winding, giving a total of 6.3 volts as shown in Fig. 512.

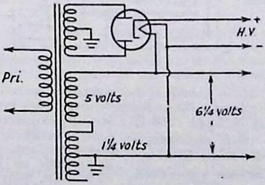


Fig. 512 — Scheme for using 5-volt winding and half of the 2.5-volt winding on old transformers to obtain 6.3 volts when desired. The substitution of a rectifier with an indirectly heated cathode is required.

When using the windings in series, they must be connected in phase. If the first connection gives less than 5 volts, reverse the leads to *one* of the windings. The total current drain should be limited to about 2 amperes, which is usually the rating of the rectifier-filament winding. As the current drain of 6-volt tubes is small, this will be sufficient for the average equipment to be powered by such a supply. — *R. R. Robinson, W8MGV.*

A SAFE AND ECONOMICAL POWER-SUPPLY CONTROL UNIT

As THE trend today in transmitter design is toward safe and foolproof operation rather than watts per dollar, we believe that the control unit to be described will be of interest to many hams.

This unit, which is a combination of the ideas of several other hams and the result of studying the cause of the misfortunes of still others, has been incorporated in the rig here at W1KSJ and has been used with very good results. Its features are as follows:

1) Provides protection against some causes of accidents, since the high voltage cannot go on unless the transmitter is grounded to earth.
2) Prevents overload of high-voltage supply.
3) Provides high-voltage time-delay.
4) Provides a stable source of bias voltage.
5) Protects tubes against bias failure.

Referring to the diagram of Fig. 513, the operation is as follows: When the main transmitter switch, S_1, is closed, all the filament transformers are on and the "hot" side of the 115-volt line is applied to the cathode of the 83V tube. When the tube reaches operating temperature (about 20 seconds), the current flows through the bias voltage divider, the Ry_2 winding and the normally closed contacts of Ry_1 to the transmitter frame, and thence back through the ground lead to the a.c. line. This energizes the Ry_2 and applies a.c. to the high-voltage transformer primary.

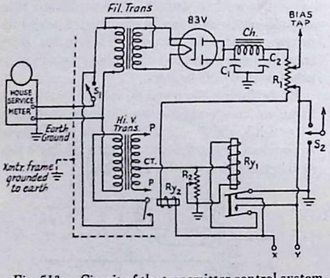


Fig. 513 — Circuit of the transmitter control system. All switches are shown in the non-operating position.

C_1, C_2 — 16-μfd. 250-v. filter condensers.
R_1 — 400 ohms, 25-watt.
R_2 — 20-ohm wire-wound rheostat.
S_1 — Main transmitter switch.
S_2 — Push-button bell switch.
Ry_1 — See text.
Ry_2 — 200- to 500-ohm d.c. relay (heavy duty contacts).
Ch — 300-ohm 30-henry choke.

In the event of overload on the high-voltage transformer, the current flowing through the selected portion of the winding of Ry_1 pulls open the pair of contacts in the bias circuit between Ry_2 and ground and, immediately afterward, closes the bias circuit again through the whole coil of Ry_1 and holds it in that position. To reset the circuit it is only necessary to push the push-button switch, S_2, which shorts out Ry_1 and Ry_2 and allows them to return to their normal position. The reset control switch, S_2, may be located on the operating table.

The only part requiring special treatment is Ry_1 which is an old "AB" power-pack relay rewound with approximately 600 turns of No. 24 enameled wire. This is tapped at about every 100 turns, accuracy not being essential. This provides a range of adjustment for wide differences in current values. The 20-ohm rheostat, R_2, provides fine adjustment.

And now for a few precautions — the relay Ry_2 should have as stiff a spring action as possible, and its contacts should be kept clean, so that they will not stick at the time its protection is most needed. In case the time-delay is not sufficient for the rectifier tubes (866s at high voltages, for instance), the push-button switch, S_2, may be held down for an additional 15 seconds, although this was not found necessary here with a 1000-volt supply. The slider on the bias divider which controls the voltage to the entire coil of Ry_1 should be set as near as possible to the ground end so too much current will not be drawn by the 83V when S_2 is closed.

The values accompanying the diagram will vary somewhat, depending on the resistance of Ry_2 and of the choke, *Ch*, and are not intended to be followed exactly. They are shown rather as an indication of what to expect. The second tap on Ry_1, to which the center-tap of the high-voltage transformer is connected, was found to give best operation with approximately 250 ma. current.

If complete break-in operation is not desired or for any reason it is felt desirable to be able to shut off the high voltage and leave the filaments and bias supply on, a switch similar to S_2 may be installed across points *X* and *Y* on the diagram. Then, if the switch is pressed, the additional magnetism in the coil of Ry_1 will cause an effect similar to that of an overload and, of course, the relay would hold shunt until the push-button, S_2, is used to reset the circuit. Should this additional control be used, it will be found necessary, however, to adjust the overload action within closer limits by means of R_2 than would otherwise be necessary.

The bias supply was found to be very steady and showed only about a 12 per cent change in voltage from zero to 50 mils of grid current to the final stage. Since the buffer stage here is also supplied from the same source and its grid current also must be added in, we believe that the regulation is quite adequate. — *Roger F. Hamilton, W1KSJ.*

—•••—

A CHEAP FILAMENT RHEOSTAT

AFTER searching for a small-size rheostat to use in series with a 7½-volt filament winding for 6.3-volt tubes, I found that the rheostats ordinarily used on car heaters work very well. The kind without an indicating light sells for about 21 cents at most auto stores and it will dissipate the heat without trouble. It is small enough to mount in a number of ways, or may be mounted in a hole like other rheostats. — *W8TLW.*

WATCH YOUR CHASSIS CONNECTIONS FOR SAFETY

Here is a safety-first idea which seems to have received meager attention in radio publications, despite its obvious importance. It concerns power supplies where the power section is made as a separate unit from the other gear.

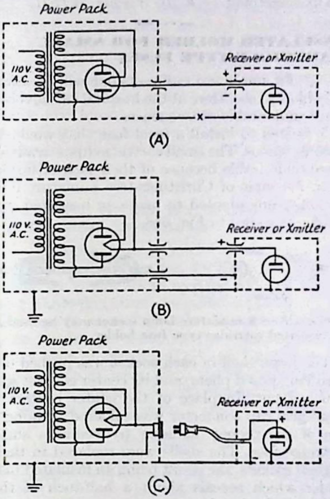


Fig. 514 — **(A) The wrong way to make connections between chassis units. (B) The right way. (C) A safe plug and receptacle system for separate units.**

Fig. 514-A shows that if the negative of the power supply is grounded to its own chassis and a negative return wire is connected between the two chassis, a highly dangerous situation can exist. If, accidentally or otherwise, the negative-return wire is broken or removed as at *X*, the full high voltage appears between the two chassis. If anyone were to place his hands on the two chassis simultaneously, he would receive the full shock of the supply. It is very easy to overlook the fact that the chassis may at any moment carry high voltage, whereas if the "B"— is carried to the receiver (or transmitter) by a separate wire, as in Fig. 514-B, all high potentials are confined to the leads which, if broken or disconnected, would be recognized as potential dangers anyway. Of course, an unsound connection of this kind is likely to be made only by the inexperienced, to whom this lecture mainly is addressed. Never under any circumstances should the "B"— be connected directly to the power-supply chassis. The golden rule for the "B" — should be, "First stop: receiver chassis."

If it is desired to have "B"— run to an external ground, this must be effected *through* the receiver frame, back via a ground wire and through the power supply chassis to ground, as at (B). Connected in this manner, no shock can result from the mere fact of a disconnected lead. My own practice, in the case of separate power packs, is to terminate the positive and negative high voltage right on the power-pack chassis in the form of a flush receptacle and connect the receiver thereto by means of a corresponding plug. Fig. 514-C shows the idea.

This is at least one sound solution of the problem, since pulling out the plug renders the power supply quite harmless. Ordinary house fittings are quite suitable electrically up to voltages of about 500 and maybe higher. — *Wm. H. H. Massy, Devon, Conn.*

* * *

SHIELD FOR EXPOSED HIGH-VOLTAGE CHASSIS TERMINALS

There always is danger inherent in the use of porcelain feed-through bushings as high-voltage chassis terminals.

The makers of Amphenol products have on the market a stamped metal shell which covers one of their standard plugs (Type C-CAB). This shell is threaded to fit a male shell of identical size. My idea is to cut one part of the shell as shown in Fig. 515-A so that it may be fastened to the chassis over the feed-through insulator. The other section then will thread onto the first, making a complete protective covering over the exposed terminal. — *George H. Goldstone, W8MGQ.*

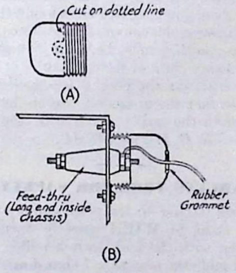


Fig. 515 — **How a shield for exposed high-voltage chassis terminals may be made from an Amphenol cable-connector shell. The insulation on the connecting wire should be adequate for the voltage employed.**

* * *

POLARIZED PLUG FOR A.C.-D.C. GEAR

In several issues of *QST* I have noticed articles suggesting just what to do when using a power supply the chassis of which is grounded to one side of the power line, especially in the use of the 117L7 and other tubes where one section of the tube is used for power and the other for oscillator, etc. Probably someone has written something about this, but I have not seen it in print.

If you will look carefully, you will find that in most of the outlets used in house wiring and passed by underwriters, the opening for the neutral prong is longer than the opening for the prong connected to the hot side of the line, as shown in Fig. 516. It looks as though they had made it for the special purpose of polarizing one side of the line. If anyone will check the sockets, he will usually find that the neutral or grounded white wire of the 115-volt system goes to the prong with the longer opening.

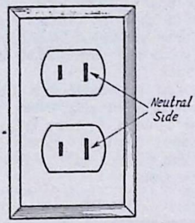


Fig. 516 — Most types of approved power outlets have prong openings of two different sizes. Plugs may therefore be polarized by flattening one of the prongs.

Now just take a hammer, flatten the prong of the plug which goes to the case or chassis, so that it will fit only the larger of the two outlet openings and there you have it. I have found this type of outlet in several homes and dime stores sell the same type, so they must be readily available in stores in many parts of the country.

Before inserting the plug, it is a good idea to make sure that the grounded side of the line *is* connected to the outlet prong with the larger opening. — *R. B. Murphy, W4IP.*

DISCHARGING TOOL FOR SAFETY

The bleeder on the power supply for the final r.f. stage at W1EH recently opened up. Thus, even with the main switch pulled, I was due for trouble the next time I shut down the rig to change bands and put my elbows on the chassis while I took hold of the final coil to pry it out of its socket. Fortunately for me, I was suspicious of the thing at the time, so I didn't get bitten.

My safety item for this hazard is a discharging tool, consisting simply of a dry 2-ft. dowel bearing at one end a U of No. 12 soft tinned bus wire.

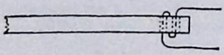


Fig. 517 — A simple safety gadget for discharging "hot" power-supply filter condensers.

As shown in Fig. 517, the wire goes through a pair of holes in the end of the dowel so it won't pull off. The wire can be readily formed to any desired shape to form a short circuit across filter output terminals, etc. When I have to change bands or otherwise touch the rig, I not only pull the main switch, but I apply the tongs across the filter terminals. When nothing happens, I know it is safe and that the bleeder is still doing its stuff. If I get a report like a pistol shot I'll know the bleeder was open, and I'll be glad I tried it.

Don't get to worrying about the surge current from the condensers and be tempted into putting a resistor in series with the shorting wire. The resistor might open up the same as it sometimes does in the bleeder. Ordinarily there will not be any current. The first time there is, it's time to fix something. — *K. B. Warner, W1EH.*

INSULATED HOLDER FOR SMALL CARTRIDGE-TYPE FUSES

In servicing radio sets one will occasionally blow a fuse. Here at the hospital this involves most undesirable consequences.

I desired to install a local fuse that would be inconspicuous. The small cartridge fuses available were undesirable because of their lack of insulation. A couple of Christmas-tree miniature bulb sockets were adapted to make an insulated fuse holder as shown in Fig. 518.

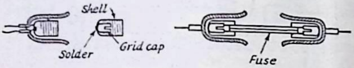


Fig. 518 — A miniature lamp socket may be used as an insulated cartridge-type fuse holder.

The brass shell in each socket was pushed out with long-nosed pliers, and its center contact was punched out. In place of the center contact a small grid cap connector was soldered, making a clip of the proper diameter to receive a small cartridge fuse. The shells were replaced in their original sockets, the result being an insulated fuse holder which reveals about a half-inch of the middle of the fuse barrel.

If insulation is not required, two grid caps alone make a useful holder. — *Harold Ramsey, Bethesda Hospital, Zanesville, Ohio.*

NOTES ON SAFER CONSTRUCTION

Power-Supply Cable Plugs

No one who has had the most casual acquaintance with power switchboards knows that there is one commandment: "Thou shalt keep all male plugs cold." We see frequent applications in multiconductor power-supply cables where the male plugs are "live." This can be dangerous to the operator if the plug is pulled apart with the power on and also can cause damage to apparatus by accidental short-circuit when a "live" prong comes in contact with ground. When power-supply and transmitter units are connected by a multiconductor cable fitted with plug connectors, the female receptacles should be mounted on the power-supply and on the transmitter end of the cable, while the male plugs should be used on the transmitter chassis and the power-supply end of the cable.

Receiver "B" Switches

A receiver "B" switch should have good insulation and the place for it is in the positive side.

Otherwise, the chassis of either the power supply or the receiver will be "hot" with the switch open, depending upon which is grounded.

Parallel Feed for Headphones

Parallel feed or output transformers always should be used in stages feeding headphones. Aside from the great advantage of safety, there are numerous other benefits which make it well worth the slight extra cost even in the most compact portable equipment. High plate currents which often damage headphones are diverted, switching between receiver or monitor is easier because one terminal is grounded, insulation is easier to carry out, and two or more receivers can be connected simultaneously. — *Yardley Beers, W3AWH.*

REPLACING AN 83 WITH 866 JR.S FOR HIGHER VOLTAGES

Every once in a while, we hear from hams who have been a little too optimistic in judging the voltage which an 83 rectifier will take. As a result they find that frequent replacement is necessary. However, it's a lot cheaper to get rid of the trouble permanently by replacing the 83 with a pair of 866 jr.s. This can be done quite simply, in most cases, since the filaments of the 866 jr.s operate at 2.5 volts, 2.5 amperes, while the 83 operates at 5 volts, 3 amperes. Therefore, it is necessary only to wire the filaments of the 866 jr.s in series to operate from the same filament transformer.

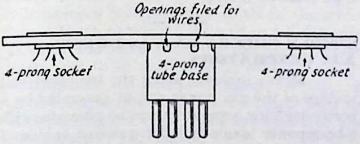


Fig. 519 — Adapter for replacing a type 83 rectifier with type 866 jr.s for higher voltages. If the rectifier filament transformer has no center-tap, make positive high-voltage connection at center of series-connected filaments. The strip is fastened to the tube base by a 6-32 screw running through the center of the tube base.

If a 4-prong tube base is available, an adapter may be made up in a few minutes as shown in Fig. 519. The shape of the mounting strip and the location of the adapter plug may be varied to suit the available space.

PLATE-VOLTAGE CONTROL WITH A COMBINATION TRANSFORMER

Many amateurs are not blessed with an abundance of funds, and a nickel saved is that much more towards improving their sets. Most power-supply diagrams show a plate transformer with two or three separate filament transformers. At the same time, most of the low-voltage plate transformers already have two or three filament windings which are not used because the boys want separate filament transformers to heat their tubes before plate current is applied.

My plate transformer has several filament windings — enough to heat my two 866 jr. tubes, as well as the filaments of the tubes in the transmitter. For 25 cents I purchased a heavy-duty porcelain double-pole single-throw switch, which I mounted on the inside of the power pack near the transformer. I brought the two plate leads from the transformer to one end of this switch and from the other end ran two leads to the rectifiers, as shown in Fig. 520. An 8-inch length of one-inch wide bakelite strip is fastened to the handle of the switch, with the loose end extending through a hole cut in the panel. When I shove the bakelite strip in about an inch the plate switch is open. All I have to do is give the tubes a few seconds to heat up when I first start up the rig and then pull the strip out, which closes the switch and applies plate voltage. This saves the price of an extra toggle switch for the plate transformer, as well as the cost of an extra filament transformer. — *W. F. Worrell, W5AQD.*

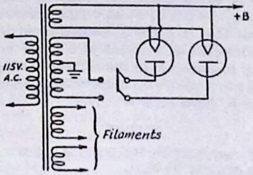


Fig. 520 — Switching the plate winding on a combination transformer so that transmitter tubes can be heated before application of plate power.

INCREASING SEMI-VARIABLE RESISTOR POWER RATINGS

The handy kink shown in Fig. 521 is very simple in principle, but for this very reason it might not have occurred to some. The power rating given a vitreous-enameled resistor of the slider-type applies to the entire resistance. Thus, when only a portion of the resistor is in use, its power rating is reduced. In other words, the current-handling ability of the wire with which the resistor is wound is the principal limiting factor. By putting the slider at the center and connecting

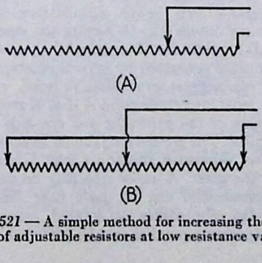


Fig. 521 — A simple method for increasing the power rating of adjustable resistors at low resistance values.

the ends of the resistor together, as shown at (B), Fig. 521, the two halves of the resistor are connected in parallel, the total resistance is reduced to one quarter of the original value, and the current-carrying capacity is doubled. If less than one quarter of the resistance is required, additional sliders may be placed at an equal distance from each end. This idea should be useful particularly in experimental adjustment of a series voltage-dropping resistor where the current through the resistance increases with a decrease in resistance. — *Elmer F. Blanchard, W1CHB.*

* * *

CABLE CONNECTORS FROM OLD METAL-TYPE TUBES

What with priorities, shortages and materials being generally unobtainable, I found one remedy for the trouble of getting an occasional connecting plug for equipment. As shown in the drawings of Fig. 522, use is made of old metal tubes salvaged from the junk pile. These are taken apart and all of the elements removed, leaving the bakelite base and the metal jacket. Holes may be drilled in the end or side of the jacket and a rubber grommet inserted to provide an opening for the cable. After the wires are soldered in the pins the jacket is slipped up and clamped on the base. The jacket may be grounded for better shielding, if desired. I have found this a good substitute for regular parts which often cannot be obtained and hope that someone else will benefit from this "brain storm." — *G. Pennington Schleicher, W9NLT.*

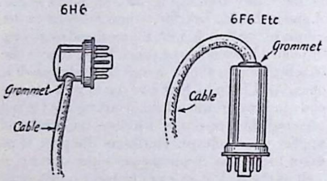


Fig. 522 — Homemade cable-plug connectors constructed from old metal tube envelopes.

* * *

ELIMINATING GAS-DRIVEN-PLANT INTERFERENCE

Frequent reference to receiver noise from gas-engine-driven power installations indicate that many others may be having the same difficulty. It happens that I have had the job of eliminating noise generated by several plants, so perhaps I can suggest some effective relief.

The most important point is that of grounding the frame of the generator *and* one side of the output line. The ground lead should be short to be effective, otherwise grounding may actually increase the noise. A water pipe may be used if a short connection can be made near the point where the pipe enters the ground, otherwise a good separate ground should be provided.

The next step is to loosen the brush-holder locks and slowly shift the position of the brushes while checking for noise with the receiver. Usually a point will be found (almost always different from the factory setting) where there is a marked decrease in noise.

From this point on, if necessary, by-pass condensers from various brush holders to the frame, as shown in Fig. 523, will bring the hash down to within 10 to 15 per cent of its original intensity, if not entirely eliminate it. Most of the remaining noise will be reduced still further if the high-power audio stages which manufacturers insist on hanging in their receivers are cut out and a pair of cans tied right into the second detector! — *Herb Walleze, W8BQ.*

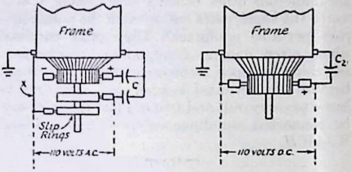


Fig. 523 — W8BQ shows the connections used for eliminating interference from gas-driven generator plants. C_1 should be 1 μfd., 300 volts, paper, while C_2 may be 1 μfd. with a voltage rating of twice the d.c. output voltage delivered by the generator. "X" indicates an added connection between the slip ring on the grounded side of the line and the generator frame.

* * *

SIMPLE CHECKS ON GAS-DRIVEN A.C. GENERATORS

Being in doubt about the frequency and voltage of the a.c. power output generated by a particular 3-kw, separately excited generator with 5-horsepower single-cylinder gasoline engine, I arrived at a simple and economical method of solving these problems.

A 60-cycle electric clock was attached to the output of the generator. Frequency checks of fair accuracy were made by comparing the speed of the second hand of the clock with that of a pocket watch. By adjustment of the engine speed to give correct rate of the second hand, the clock may be made to keep fairly accurate time.

Operating the transmitter while varying the speed of the engine, it was found that the transformers operated best in the frequencies between 50 and 60 cycles, the efficiency dropping off with operation outside of this range.

It was further found that a light bulb connected across the output of the generator was far from a reliable check, since the voltage required to produce what seemed normal brilliancy of the bulb on bright sunlight days was in the neighborhood of 150 volts. Accordingly, the light bulb was replaced by a Readrite a.c. voltmeter. This instrument has been found satisfactory for the adjustments required to maintain correct output voltage of the generator.

It should be noted that, if a 50-cycle clock is used to check the frequency of a generator, delivering 60-cycle a.c., one revolution of the second hand should be made in 50 seconds, and therefore the clock should gain a total of 4.8 hours in each 24-hour day.

With the employment of this inexpensive equipment for checking the operation of the generator, stable operation with both regenerative and superheterodyne receivers is maintained. — *Dan Nightingale, W5EGV.*

—···—

FILTERING GENEMOTORS USED TO SUPPLY RECEIVERS

It is possible to install a genemotor and filter for use as a receiver power supply with a minimum of commutator ripple appearing in the receiver output, even though no method has been devised, thus far, to eliminate the "whine" from the background.

Methods employed in present-day aircraft receivers in mounting the genemotor should be the amateur's guide. The support should be in the form of rubber mounting blocks, or their equivalent, to prevent the transmission of vibration mechanically. The frame of the genemotor should be grounded through the use of a heavy flexible braid connector.

The brushes on the high-voltage end of the shaft should be by-passed with 0.002-μfd. mica condensers to a common point on the genemotor frame, preferably to a point inside the end cover, close to the brush holders. Short leads are absolutely essential.

Sometimes it is necessary to shield the entire unit, or even to remove the unit to a distance of three or four feet from the receiver. Shielded leads seem to be of little or no help.

A filter for the genemotor should be designed in very much the same manner as those used for vibrator supplies. Such filters are shown in *The Radio Amateur's Handbook.*

A 0.01-μfd. 600-volt (d.c.) condenser should be shunted across the output of the genemotor, followed by a 2.5-mh. r.f. choke in the positive high-voltage lead. From this point the output should be run through a "brute force" smoothing filter which uses, say, an 8-μfd. electrolytic condenser on each end of a 15- or 30-henry filter choke having low d.c. resistance. — *Harris C. Haines, W8IBQ.*

—···—

BREAK-IN OPERATION WITH DYNAMOTOR SUPPLY

For those fortunate enough to have a.c. available, break-in is so simple there is no excuse, it seems, for not using it. But for the ham who must depend on a dynamotor or a motor-generator set it may not be such a simple matter. The dynamotor formerly used at this station made so much QRN that even an S9 signal was copied with difficulty.

After making a number of inquiries as to possible remedies, I was none the wiser and about to give up. R.f. chokes and condensers up to 20 μfd. across the brushes did not improve matters much, if at all. The machine was enclosed in an iron casting, so that shielding it further did not seem to hold much promise.

However, I decided to try something. With the aid of the soldering iron, a box with a tight-fitting cover was made from galvanized-iron sheet. It was made with two compartments. In one, the dynamotor was mounted on heavy felt padding to absorb vibration and thus eliminate much of the QRN coming through the air, and also to insulate the machine completely from the sheet-iron box. That may be of importance. Two 2-μfd. condensers were connected in series across the primary, or motor, brushes. The center-tap, or the connection between the condensers, was grounded to the dynamotor frame. Lead-covered cable was used to connect the primary to the storage battery. The sheath of this cable makes contact with nothing except the metal box.

In the other compartment was placed the starting relay, a Ford generator cut-out, and three chokes, one in series with the lead to the starting relay, and one in each secondary or high-voltage lead. The chokes are "shuttle" type, and are wound with about 325 turns of No. 28 d.c.c. They are separated as far as possible in the box and the center one is wound in the opposite direction from the others.

The particular dynamotor in use is a General Electric 24/750-volt machine, which has a 1-μfd. condenser in the base to filter the high voltage. Using crystal control, T9 reports are received on all bands even without the filter, but it helps to minimize sparking at the brushes. With the load off, the h.v. QRN is of little consequence. The entire output is keyed with another generator cut-out relay so there is no load on the machine when the key is up. The advantages of the idea are break-in on any frequency, less current drain on the storage battery, and greater output resulting from the greater speed of the armature because of the "fly-wheel" effect. This procedure would, perhaps, not be advisable unless the transmitter in use is crystal-controlled, although dynamotors in general have very good regulation unless they are greatly overloaded.

After the cover was put on the box, it was a pleasant surprise to find the generator hash had cleared up enough so that all signals except the very weakest could be copied with the machine running, making c.w. break-in and 'phone push-to-talk operation possible.

All of the precautions I took may not be necessary in all cases, but a few additional suggestions may help in curing more stubborn ones. A large choke in each primary lead, wound with No. 10 to No. 14 enameled wire, may be useful. Shuttle-type chokes are very compact but effective. By habit I connect the inside terminal to the output or cold side of the circuit. Sometimes chokes are more effective if individually shielded in small tin boxes such as Kester solder boxes. Different-sized chokes may be tried. Grounding the metal box may help, but in my experience "floating" shields are more effective as a rule. — *Robert E. Valgren, W9ALO.*

BIAS SUPPLY FOR "ZERO-BIAS" MODULATORS

Batteries proved to be noisy nuisances when used for grid bias on my Class-B 805s which require about 15 volts. The solution to the problem turned up a novel use for a mercury-vapor rectifier as a regulator in conjunction with my regular a.c.-operated bias pack furnishing voltage to the grids of the r.f. amplifiers. Except for supplying the mercury tube with filament power, the action is the same as that of the well-known 874, or its more modern version, the VR105/30. In this case, however, the output voltage is about 15 volts because of the mercury-vapor tube's constant voltage drop of that value.

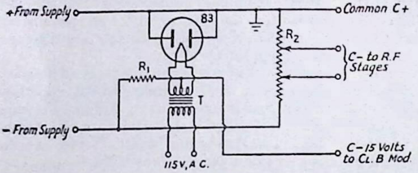


Fig. 524 — Circuit diagram of the combination bias supply described by W8HLM. The branch with the 83 rectifier-regulator supplies a constant regulated voltage of 15 for the Class-B modulator tubes.

The circuit diagram of the combination bias supply is shown in Fig. 524. Resistor R_1 should be of a value such that the mercury vapor tube draws only enough current to glow dimly (but reliably) with the biased stage not drawing grid current (about 20 ma. in the case of an 83 tube). The rectifier tube which should be used will depend on this resting current plus the peak grid current of the biased stage. The sum of these currents should not exceed the maximum d.c. output current rating of the tube.

Using an 83 tube to regulate a circuit in which the grid current varies from 0 to 40 ma. the voltage is held steady to within 0.1 volt or so, which is better than dry batteries used to do. Substitution of an 866 brought the variation to an even lower value, but this refinement is not needed.

Bias for the r.f. tubes is taken in the usual manner from the output voltage divider. — *Charles Affelder, W8HLM.*

—···—

IMPROVED VOLTAGE REGULATION FOR THE OSCILLATOR

In attempting to operate a self-excited oscillator and power amplifier from the same power supply, I encountered considerable difficulty with poor voltage regulation. A standard single-section choke-input filter system was used with an 83 rectifier and a transformer delivering 600 volts each side of center with a 200-ma. rating. The choke was a double 30-henry unit with the two sections connected in parallel. Each unit has a 125-ma. rating.

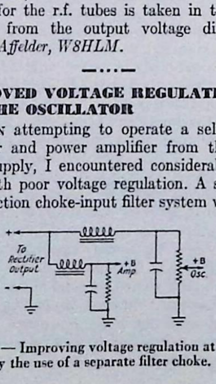


Fig. 525 — Improving voltage regulation at the oscillator tap by the use of a separate filter choke.

Investigation showed that most of the drop in voltage was occurring across the filter choke. Upon arranging the circuit as shown in Fig. 525, so that the amplifier current was drawn through a separate choke section, I found that the voltage at the oscillator voltage-divider tap remained practically constant when the amplifier was keyed. A 4-μfd. condenser in each branch provided sufficient smoothing. — *John H. Stone, W8MYQ.*

—···—

POWER-TUBE PROTECTIVE CIRCUIT

The writer has used the method shown in Fig. 526 to protect the power tubes and eliminate complete breakdown of a p.a. amplifier in case of failure of the fixed-bias system normally used. In this case, the tubes were a pair of 2A3s drawing a normal plate current of about 80 ma.

Across the usual self-bias resistor was shunted a Little-Fuse, rated at 125 ma. If the fixed-bias system failed, the plate current on the power tubes would exceed the rated carrying capacity of the fuse and it would blow, thereby removing the shunt across the self-biasing resistor and automatically putting the tubes in normal operation with self bias. The grid return would be through the bias-supply voltage divider to ground. As an added protection, a fuse of the same rating was used in series with the bias resistor.

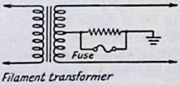


Fig. 526 — Power-tube protective circuit for use on fixed-bias stages. It employs an auxiliary self-biasing resistor which is normally shorted by a fuse.

This idea probably can be applied in other ways. In a transmitter, it might be adapted to an overload relay circuit which would remove a short across a self-bias resistor calculated to reduce plate current to a safe value when off resonance, instead of opening the plate circuit and killing the transmitter. — *Henry C. Kuhn, W8IRU.*

—···—

A METHOD OF REJUVENATING ELECTROLYTICS

I would like to pass on a method which I have found to be effective in rejuvenating 90 per cent of wet electrolytics. The reason for the failure of these condensers seems to be a thin dielectric film which forms at the junction of the aluminum anode and the supporting rod.

The unwanted film can be removed by connecting the condenser in series with a 40- or 60-watt lamp across the 240-volt a.c. mains. Usually nothing happens for several minutes. Then the film suddenly breaks down, causing the electrolytic to sizzle and the lamp to light. The power should then be switched off and the condenser reformed by connecting it to a d.c. supply of several hundred volts for about ten minutes. After this it will generally be found that the condenser has acquired a new lease on life.

Obviously, if there is no electrolyte in the condenser to start with, this method will not work. — *VK2ABS, in* Amateur Radio (*Australia*).

—•••—

GASEOUS TUBES AS BIAS REGULATOR

Arrangements using gas tubes (such as VR or 0Z4) for bias work out nicely if properly handled and provided the current through the tubes is fairly high, that is, near the current limit for the tubes. At low currents, the tubes are inclined to oscillate and if this occurs, modulation of the transmitter is bound to result. — *R. M. Purinton, W2ICU.*

—•••—

WHY NOT PROVIDE OVERLOAD PROTECTION FOR YOUR EQUIPMENT?

The radio amateur and experimenter often has need for a device that will limit the amount of current that can be supplied to a changing load. This load may be a grid-leak-biased transmitter stage which tends to draw excessive current when out of tune or overcoupled to an antenna, or one of those ultrahigh-frequency, high-power oscillators which tend to run away when loaded too much. The conventional fuse, while giving satisfactory protection, is inconvenient. A fuse with a rating sufficiently low to provide adequate protection may be blown during the normal adjustment procedure. Replacing fuses also becomes costly if done very often. A circuit-breaker eliminates the necessity for replacement of fuses, but it has the disadvantage that if it is set to provide the maximum protection, it will often open and need resetting even when the equipment is very near to its proper adjustment. Reducing the plate voltage supplied to the transmitter while adjustments are being made and selecting a fuse or overload relay of suitable value is a possibility, but this procedure is somewhat inconvenient. A series resistor often is used to supply voltage to such variable loads, but this is rather wasteful because, even under operating conditions, there is a certain amount of power lost in the protective device. A handier protective device would allow normal operation up to a predetermined current level and then function to prevent this value being exceeded, regardless of output load or applied voltage.

Such a device may be conveniently constructed from a normally closed d.c. relay. The exciting coil of the relay is shunted so that the relay will open when the desired limit current passes through the winding-resistor combination. This coil is then connected in series with the relay contacts as shown in Fig. 527-A. The relay is placed in series with the lead supplying current to the device to be protected. While the current drawn by the equipment is lower than the desired limit, the protective device will have no effect on this current or voltage. Above the overload point, the relay will open, causing the current to be shut off from the equipment. Shutting off the current will then de-energize the relay coil so that the contacts will again close. This process will be repeated at a rate determined by the amount of excess current that the protected device tried to draw.

A typical operating characteristic is shown in Fig. 527-B. In this case, the relay was placed in series with a resistor and the voltage across the combination varied. The current through the resistor was plotted against this voltage variation. It will be noted that the current to the resistor was directly proportional to the applied voltage until the predetermined current value was reached. The current then dropped slightly as the supply voltage was increased. For a two-to-one increase in supply voltage, the current through the resistor stayed within 15 per cent of maximum, never exceeding this value. This characteristic will vary slightly with the particular relay chosen. The opening and closing of the relay will cause a modulation on the current supplied to the load. In most cases this will not be objectionable, since the device will operate only when the protected equipment is overloaded. If desired, a part or all of this modulation (and interference with other equipment) can be removed by use of resistor-capacitor filters, or inductor-capacitor filters, such as are commonly used for the elimination of keying interference in c.w. transmitters.

In choosing a relay, care should be taken to pick one that has sufficient spacing between the contacts so that the high voltage present across them when the relay is open will not start an arc. If an arc forms, the circuit will not open and the protective device will be of no value. For experimental purposes, it is often convenient to place a variable resistor across the relay coil so that the operating current may be set at will.

A small d.c. relay shunted with a 250-ohm wire-wound rheostat makes a suitable protective device for small transmitters drawing not more than 150 ma. at 400 volts. These relays usually open with a coil current of 10 to 20 ma.

The system has been used in the laboratory in the development of several pieces of equipment in which it had previously been necessary continuously to replace fuses or run the risk of destroying expensive tubes. — *H. C. Lawrence, W3IXL.*

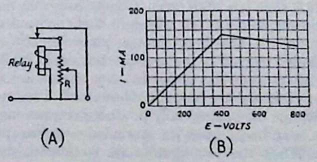


Fig. 527 — Overload protection system suggested by W3IXL. (A) shows the relay circuit, while the curve at (B) shows the output current *vs.* input voltage when used in series with a resistor as mentioned in the text.

A SAFETY SWITCH FOR THE POWER SUPPLY

An inexpensive idea for power-supply switching which, if properly used, may save the operator from painful shocks is shown in Fig. 528. A double-pole double-throw switch is used in the position normally occupied by a single-throw single-pole switch. One pole performs the function of opening the plate transformer primary circuit, while the other pole, on the opposite throw, shorts the output terminals of the plate supply. This removes the chance of shock by condenser discharge if the bleeder circuit should be opened and, in addition, it reduces the danger of having high voltage appear in the power supply because of accidental primary circuit closing through a path external of the switch.

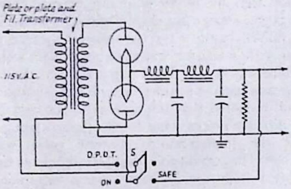


Fig. 528 — Power-supply filter discharging switch.

Two precautions should be carefully observed in the use of this switch, however, without which it may prove a hazard rather than a safety device. First, the moving part of the section used for output shorting should be connected to the ground power supply terminal, with the stationary pole connected to the other high-voltage terminal. Second, if an open knife switch is used, the stationary pole of the shorting section should be made inaccessible to accidental contact with the operator's hand or body. The switch should be enclosed completely or of a type which may be mounted with the "works" behind a panel or in a control box. — *Everett G. Taylor, W8NAF.*

* * *

GROUNDING THE POSITIVE HIGH VOLTAGE FOR SAFETY

The desire to "switch to safety" and to build an inexpensive r.f. amplifier led me to adopt the circuit shown in Fig. 529. Although the idea is not new, I think it deserves much more consideration than has been given. Comparison with the orthodox circuit at (B) will show that the *positive* terminal of the high-voltage plate supply is grounded instead of the negative terminal. While this involves certain problems, they are not insurmountable and are brought about chiefly because the design of commercially produced components have been based upon the grounded-negative circuit. When the two circuits are compared, the advantages of the grounded-positive version are quite apparent. Almost without exception, those parts of the circuit which normally are exposed sources of danger in the grounded-negative circuit are grounded and, therefore, are harmless in the grounded-positive circuit. The tank coils, tank condensers, plate-circuit milliammeter, tube plate terminal and filter chokes are at ground potential and the adjusting shaft of the neutralizing condenser also is grounded. Another advantage is that no difference of d.c. potential exists between the rotors and stators of the split-stator condenser, and therefore the tank condenser must withstand only the peak r.f. voltages.

On the other hand, the filament and d.c. grid circuits are at high d.c. potential in respect to the chassis or ground, and these circuits must be suitably insulated. Fortunately, these portions are the ones which usually are hardly accessible to accidental contact. The filament by-pass condensers must have a voltage rating somewhat greater than the plate voltage used. The same sort of insulation is required between the primary and secondary windings of the filament transformer. All components of the bias supply also must be well insulated from ground, including the rectifier filament and plate-transformer secondaries. Batteries might be used for low-voltage, high-μ tubes but they must be placed at an inaccessible point on well-insulated mountings. The grid coupling condenser must withstand the sum of grid and plate voltages. Some of these difficulties may be avoided by obtaining bias from a voltage-divider across the plate-voltage supply, connecting the grid return to the negative high-voltage and filament center-tap at an appropriate point on the divider. With high-μ tubes, the sacrifice in plate voltage will not be appreciable. — *Arpard A. Fazakas, W2FLT.*

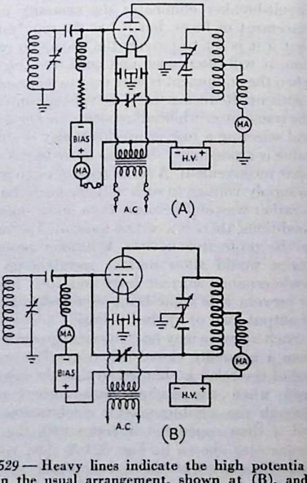


Fig. 529 — Heavy lines indicate the high potentia points in the usual arrangement, shown at (B), and those in the grounded-positive arrangement at (A).

OPERATING STAGES IN SERIES FROM A HIGH-VOLTAGE POWER SUPPLY

THE problem of using a single power-supply unit for a transmitter of several stages, some of which may operate at different voltages, is always a difficult one. It usually is solved by the use of inefficient dropping resistors. In contrast to this, Jim Blitch, W4IS, describes a rather novel way in which an entire c.w. transmitter is operated from a single 1500-volt supply.

The essentials of the circuit are shown in Fig. 530. The transmitter in this case consists of four stages: 6F6 Pierce oscillator, 6L6 buffer, 809 driver and push-pull 808 final, all operating at different voltages. Since the oscillator is designed to operate with very-low plate current, plate voltage may be obtained without great loss in power through the series dropping resistance, R_4. The voltage is prevented from soaring by the VR-105 tube.

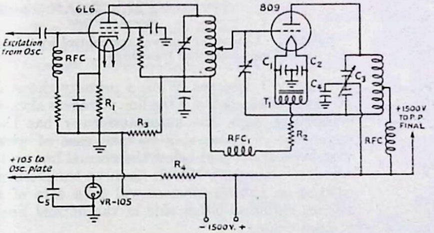


Fig. 530 — Two stages operating in series from a single high-voltage supply. All circuit values differing from those which would be normally employed are discussed in the text.

The innovation in the system is in the manner in which the two intermediate stages are supplied. As the circuit diagram of Fig. 530 shows, these two stages are connected in series across the supply, the series circuit from the positive high-voltage terminal being through the plate circuit of the 809 to its filament center tap, thence to the plate circuit of the 6L6 whose cathode forms the return connection to negative high voltage. Since the 809 normally operates with a higher plate current than the 6L6, and since the current throughout the series circuit must be the same, the 6L6 is shunted by the resistance R_3 which is proportioned to carry the difference between the plate current of the 809 and that of the 6L6. This point may be made clearer by comparing the circuit with that of series connected heaters, commonly found in a.c.-d.c. receivers. In cases where heaters of unlike current ratings are connected in series, those of lower current rating are shunted by resistors which limit the voltage across the heater terminals to the proper value when rated current is flowing through the heater of highest current rating.

Bias for the 809 is obtained by the drop across the cathode or center-tap resistance, R_2, by-passed by C_1 and C_2. To obtain this bias, the grid is returned through L_1 and RFC_1. Since no coupling may be used, excitation is adjusted by a variable tap on L_1.

The idling plate current may be adjusted by varying the value of cathode resistance, while the input to the 6L6 can be controlled by adjusting the size of R_3.

All values not indicated are normal. The filament by-pass condensers, C_1 and C_2, and the filament transformer, T_1, should have voltage ratings of not less than 1000 volts. If a d.c. connection is made to the rotors of C_3, as shown in the diagram, a tank condenser with normal plate spacing may be used. However, if the rotor is grounded, the spacing must be increased to take care of the full supply voltage (1500 in this case) plus the peak r.f. voltage. C_4 should be rated to withstand full supply voltage. For the particular arrangement shown, 900 ohms, 25 watts and 25,000 ohms, 25 watts are appropriate values for R_2 and R_3, respectively. Also in this particular instance, the dropping resistor, R_4, is 37,500 ohms. C_4 should have a voltage rating proportional to the full supply voltage. A resistance of 100 ohms for R_1 should be suitable.

This circuit has proved entirely practicable here. However, such an arrangement is not suitable for 'phone work.

—···—

FILTER-DISCHARGING RELAY OR SWITCH

I BELIEVE the arrangement shown in Fig. 531 is an improvement over the usual filter-shorting relay circuit. It is a scheme which has been used by the Italian Marconi people in certain types of their short-wave transmitters, in which changes in tank-circuit values are made by operating bare switches in a 3500-volt series-fed circuit.

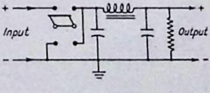


Fig. 531 — Safety switch which opens the high-voltage circuit as well as discharging filter condensers. Switching is done by a protected knife switch or relay.

A double-pole double-throw relay or switch is connected so that the filter is disconnected from the rectifier before the filter is short-circuited. This automatically prevents the possibility of damage to the transformer and rectifier as well as injury to the operator should he fail to switch the supply off before shorting the output or by failure of the shorting relay to operate properly.

As used by the Marconi Co., the switch is manually operated by an insulated control from the panel. Of course, if a relay is used, the stationary contacts must be well insulated from one another. — *Keith Olson, W7FS.*

AN INEXPENSIVE-TIME DELAY RELAY

Time-delay relays, though almost a necessity in the up-to-date transmitter, are often avoided because of the cost. However, an ordinary power-remote control relay can be made to do the trick by the addition of a flasher and lamp bulb. The flasher may be of the small disc variety which may be obtained at any electrical store.

Fig. 532 shows one circuit arrangement using a double-pole double-throw relay. Initially the lamp and flasher are in series across the 115-volt line and the relay coil is across the flasher. When the flasher heats up sufficiently to open, the relay coil is energized, whereupon the lamp and flasher are disconnected, and the relay coil together with the load are connected directly across the line. It should be noted that this relay should be of the quick-acting type, with a fairly heavy armature, otherwise it will not hold in properly when the flasher opens.

Should the relay at hand not prove suitable for use as in Fig. 532, the circuit shown in Fig. 533 may be used. Here the relay is always connected in series with the lamp, but is shorted out by the flasher until the latter warms up sufficiently to open. Having the relay in series with the lamp is not a material disadvantage, providing it receives sufficient energy for correct operation. If the relay draws considerable current, a larger bulb and flasher may be used.

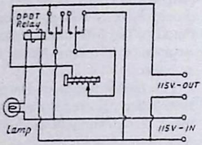


Fig. 532 — A simple time-delay relay circuit using a d.p.d.t. power relay and flasher.

For most purposes, a flasher suitable for use with a 60-watt lamp will give good results, the time lag, of course, depending on the bulb used and any possible adjustment on the flasher itself. Time lags longer than about 20 seconds are inclined to be rather unstable; hence this type of relay is not altogether suitable for such service.

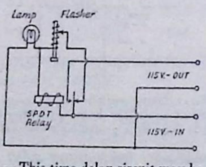


Fig. 533 — This time-delay circuit may be used with a s.p.d.t. relay operating on low current.

A suggested arrangement is to mount the lamp bulb and the flasher in a twin plug fuse receptacle, with a plug fuse to complete the circuit through the flasher. A refinement would be to substitute a resistor for the lamp bulb and a special mount for the flasher. — *Wilbert B. Smith.*

A SIMPLE LINE-VOLTAGE CONTROL

The dodge of using a spare filament transformer as an auto-transformer for compensating for variations in line voltage often has been suggested but apparently has never gained the popularity it deserves. While a primary rheostat gives a smooth control if the line voltage is always sufficiently high, the autotransformer has the advantage of being able to take care of wide variations above and below the normal line voltage. For example, a 10-volt filament transformer used as an autotransformer will take care of a 10-volt variation either side of the normal line-voltage value.

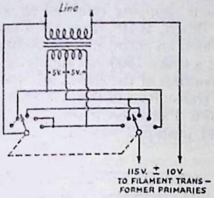


Fig. 534 — Circuit for line-voltage control by means of a center-tapped filament transformer.

In order to facilitate adjustment, a simple switching system can be used, as is shown in Fig. 534. The switch can be any double-pole five-position job that isn't too flimsy. Any of the better switches should do the trick nicely. The transformer can be any spare filament transformer — we use an old 7½-volt one but plan to scare up a 10-volt one for slightly more range of control. The voltage is controlled in steps equal to half of the secondary voltage of the transformer used. — *W1JPE.*

—···—

POLARITY OF SUPPLY LINE IN REGARD TO SAFETY

To make certain that the switch or other device is always placed in the ungrounded side of the line, the use of polarized outlet plugs, which cannot be reversed, is suggested by many, while others provide a signal lamp connected with the series outlet as shown in Fig. 535. If the polarization is correct, the lamp will light when the short-circuiting *plus* is inserted but will not light if the polarization is incorrect. If the lamp does not light, the power plug should be reversed to make certain that the light has not burned out. The lamp serves as a warning light when power is on.

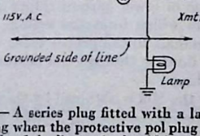


Fig. 535 — A series plug fitted with a lamp is useful for indicating when the protective pol plug is in the ungrounded side of the line as it should be.

6. *Hints and Kinks . . .* for the Antenna System

THREE-BAND "AUTOMATIC" ANTENNA

Fig. 601 is a sketch of a novel antenna system which has been working out satisfactorily for Frederick Weyerhaeuser, W9YPQ. As most amateurs know, a center-fed antenna with twisted feeders is good for operation only in the band for which the antenna is cut. W9YPQ gets around this situation by using three antennas, one for each band, but all fed through a common low-impedance feeder. Only the desired antenna will take power because the others are the wrong length for resonance. The shorter antennas are suspended from the longer by means of glass-rod spreaders so that the spacing between wires is 4½ inches.

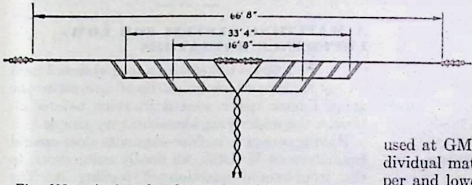


Fig. 601 — A three-band antenna with twisted-pair feeders. Three separate antennas are used with the same feed line. The feeder is fanned at the upper end so that the spacing on the 40-meter antenna is 12 inches.

W9YPQ writes: "The fact that different center spacings are required for proper impedance matching of a twisted pair to a 7-, 14- or 28-Mc. antenna suggested combining all three of them to a single feeder. Local field-strength measurements and DX results are comparable to separate half-waves of the same type. The feeders at present are No. 18 stranded rubber-covered wire, and it is hoped that even better results will be had with more efficient feeders. The theoretical value for center spacing was used only on 7 Mc.

"The tuning characteristics on each band are identical with those of separate antennas, and a neon bulb indicates the presence of r.f. in the desired section only."

One point about such an antenna system is that it does *not* possess the ordinary twisted-pair feeder's harmonic-discrimination. Therefore harmonics must be eliminated before they get to the feeder.

A FLAT LINE FOR THE "LAZY H" ANTENNA

The difficulty of adjusting a matching stub for a perfectly flat line is well known. The principal reason for this lies in the fact that the stub shows pure resistance only at its ends and not at the point at which the flat line is attached unless the stub is detuned slightly.

To eliminate this, the arrangement shown in Fig. 602 has been used at GM6RG with a "lazy H" antenna. Individual matching sections are connected to upper and lower sections of the antenna. The one for the upper section is transposed and is three-quarters of a wavelength long to bring its lower end down to meet the one-quarter wavelength section attached to the lower antenna section. A "Q" matching section is then used between the two open-wire matching sections and the 600-ohm line. When the "Q" section is correctly adjusted, the line will be terminated in a pure resistance. The impedance at the antenna end of the "Q" section will be about 15 ohms. — *Bryan Groom, GM6RG.*

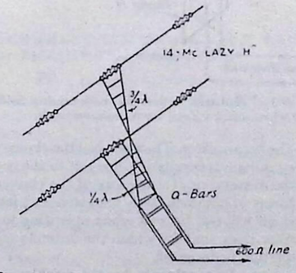


Fig. 602 — The arrangement by which GM6RG obtains a flat 600-ohm line with "lazy H" antenna.

—•••—

The construction and adjustment of "Q"-section transformers are discussed fully in the Radio Amateur's Handbook (p. 209 of the 1945 edition) and in *The ARRL Antenna Book* (p. 48).

A MULTIBAND END-FED ANTENNA

When multiband operation of an end-fed antenna is desired, the annoying problem of how properly to feed it always presents itself. It is often necessary, and sometimes desirable, to erect a transmitting antenna in such a way that an end is near the transmitter. Then one has the choice of either running a transmission-line out to the center of the system, or of using any of the conventional forms of end-feed with the attendant feeling that all will not be well when operating in a band other than that for which the antenna and feeder-system is designed.

One convenient solution to the problem of multiband operation of a Zepp antenna has been found. Take, for example, an antenna with a natural period of 1.75 Mc., together with the usual feeder-system consisting of a ¼-wave transmission line. This is a typical antenna-feeder system which we may wish to operate on 3.5, 7 and 14 Mc., as well as the wavelength for which it is designed. To this system there can now be added another feeder, equally spaced from both the original feeder wire and the antenna, but of length ¼-wave at 3.5 Mc. Two more feeders also can be added of lengths ¼-wave at 7 Mc. and ¼-wave at 14 Mc.; all equally spaced with respect to the other feeder wires and to the antenna as shown in Fig. 603. This results in a four-band Zepp system which performs equally well on any of the four bands and which maintains a current-loop at or near the transmitter.

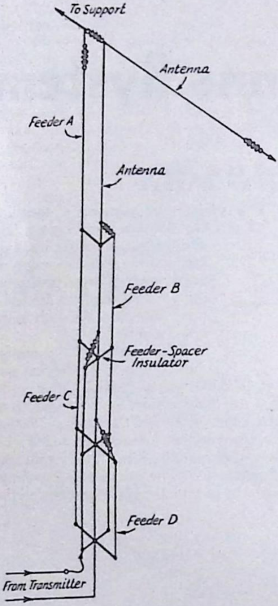


Fig. 603 — Multiple feeders for maintaining feeder balance when using a Zepp for multiband work.

One may, with justification, ask about the length of the antenna itself, since it cannot be of exactly the right length for all of the bands. Experiment has shown that any random length is satisfactory and that almost complete compensation may be made in the transmitter matching network. Somewhat better results are evident when the antenna-length is great (of the order of 300 feet or more) than when the length is small, although both long and short wires operate successfully. Two such systems were in operation for over two years, while perfect contact was maintained over a 12,000-mile path on two different bands. — *S. L. Seaton, VK6MO, Dept. of Terrestrial Magnetism, Carnegie Institution of Washington, D. C.*

—…—

A MATCHING SYSTEM FOR LOW-IMPEDANCE RADIATORS

Fig. 604 is a sketch of a feed system I used on my rig here which might be of interest to the gang. I have never seen it in print before, although the underlying ideas are very simple.

Having erected a four-element close-spaced beam here at W6DSZ, we finally came down to the troublesome question of feeding it. The radiator's center impedance of only 5 ohms or so presented a problem, since we wished to use open-wire lines, if possible, and yet be able to rotate the beam without having to resort to slip rings or similar means. We finally hit upon the idea shown, which seems to work very well.

Beginning at the antenna end, the piece of EO-1 cable is delta-matched to the antenna at the center. This cable is just long enough to pass through the center supporting shaft with enough

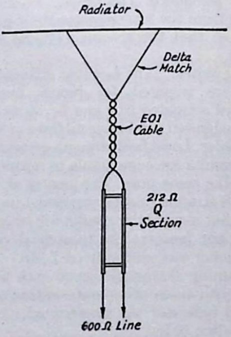


Fig. 604 — Feeding low-impedance beam radiator. In the specific case described by W6DSZ, the delta is attached 30 inches from each side of the center of the 14-Mc. radiator element of a four-element beam. The distance from the center of the radiator to the junction with the EO-1 cable measures 60 inches.

slack to turn the beam around. The bottom end of the EO-1 cable is matched to a 600-ohm line with a standard 20-meter Johnson "Q" section. Of course, a home-built quarter-wave section of 212 ohms surge impedance will do as well.

The advantages of this system are obvious. First, since only enough EO-1 cable is used to reach through the supporting shaft, losses due to long lengths of this cable are reduced. Second, since the section that is used is operated as a flat 72-ohm line, rather than as a "Q" section as some systems use it, losses are further reduced to the absolute minimum possible with this type of line. In our case where only 6 feet or so is used, losses are considered negligible.

In operation, the 600-ohm part of the line shows substantially the same r.f. voltage and current along its length; the voltage falls off gradually as we progress up the "Q" section toward the antenna. The voltage is very low all the way up the EO-1 cable to the antenna — scarcely enough to light a ½-watt neon lamp even with a full kilowatt input in the transmitter.

We might also mention that the antenna can be rotated four times in either direction without any difficulty from the feeders twisting up.

With suitable change of the "Q" section length and spacing of the delta match, this system could be used on any type of beam having radiation resistance less than 72 ohms and at any frequency. — *Fred Clapp, W6DSZ.*

* * *

ADJUSTING THE DELTA-MATCH SYSTEM FROM THE GROUND

The problem of impedance matching between an antenna which is part of an array, and its feed line is often a hard one, because of the difficulty of computing or measuring the impedance at the points of connection to the antenna.

Since cut and try methods must be employed, it is advantageous to use a matching system which is continuously variable over a considerable range. The matching stub with its feed line tapped on at the proper point, and the "Y"-match seem to be the most flexible systems. Using either system, the approximate spot is chosen for tapping on and the taps are then varied until standing waves are eliminated from the feed line. Adjustment of the taps often is a tedious and physically difficult task, because adjustments must be made while the antenna is in the position in which it is to be operated.

The "Y"-match antenna can be adjusted in another manner which greatly simplifies the whole procedure and which should prove very valuable in making adjustments on beam antennas where the whole array is mounted so as to be accessible only with difficulty. The "Y" antenna, as shown in Fig. 605, can be thought of as a grounded quarter-wave antenna with a single-wire feed line. The portion to the left of the dotted line represents the image in the earth. The feed line is correctly terminated when the resistance presented to the feed line at point P_2 (assume a resonant wire) is equal to the characteristic impedance of the feed line. This resistance is a function of the length of the wire, L_1, its characteristic impedance, and the impedance presented to it at P_1. It has been customary to secure the correct resistance at P_2 by changing the position of P_1, thus changing the load presented to P_1, the length of L_1, and the characteristic impedance of L_1 (by changing its average height above ground).

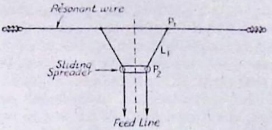


Fig. 605 — Scheme suggested by W9RQG for making final adjustments of a delta match from the ground.

This same result can be achieved by moving the sliding spreader at P_2, thus changing the length and impedance of L_1. It is not possible to get as great a variation by this method as by moving the taps, but if the points of tapping are roughly correct it should be possible to secure a match with reasonable movements of the spreader from its original position, as determined from tables in *The ARRL Antenna Book*, or in *The Radio Amateur's Handbook*.

The system can be raised to its operating position and the spreader moved up or down by means of a long fish pole with a hook or clamp attached to its end. When the proper position is found, the spreader can be wired in place. — *Victor H. Voss, W9RQG.*

* * *

INCORRECT USE OF 115-VOLT LAMPS TO TERMINATE RHOMBICS

In a number of contacts with amateurs using rhombic antennas, dissatisfaction with them in many cases was found to arise from termination in 115-volt lamps. A Mazda lamp calculated by Ohm's law at 330 ohms was used for a series of resistance measurements at different power dissipations, and it was found that the resistance of the unheated filament is approximately 60 ohms, less than one-fifth of the heated value.

Thus, many of the installations making use of lamps have actually presented terminating impedances far from the expected values, and have resulted in improper operation of the systems, probably more often than not dissipating disproportionately large parts of the transmitter output, and leading to standing waves on the rhombic and feeders.

Even though lamps are carefully chosen for proper resistance at the working load, keying the carrier results in rapid change of the terminating resistance, and thus in the radiation of the system. This means that satisfactory use of lamps for termination is almost entirely limited to 'phone operation with output power confined to narrow limits. — *L. F. Sherwood, HH4AS.*

A FIXED-POSITION THREE-ELEMENT DIRECTIVE ANTENNA

EXPENSIVE three-element rotatable beams are enjoying widespread use on the 14- and 28-Mc. bands, but it doesn't seem to be generally realized that a three-element *fixed* beam can be built for little more than an ordinary half-wave antenna. As a matter of fact, the one that was used at W5CXH for more than six months cost only $2.00 complete, including the 50-foot feed line. Since, by checking back in the log, it was found that about 80 per cent of the contacts with the old half-wave antenna were in one general direction, the logical thing to do was to replace the half-wave with a unidirectional beam of definite gain for that direction.

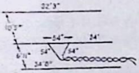


Fig. 606 — The fixed-position three-element directional antenna used by W5CXH.

The elements were made of regular No. 12 antenna wire, and fishpoles were used to separate the elements. A twisted pair made of No. 12 house wire was used to feed the radiator, and a delta match was used between the radiator and the line. The dimensions of the system are shown in Fig. 606. An open line, delta-matched to the radiator, might have had less loss, but would have increased the cost.

Tilting this three-element fixed antenna brought several interesting facts to light. First, with the antenna at a height of ¾-wavelength, tilting the antenna system about 35 degrees above the horizontal seemed to give maximum field strength at distances less than 1200 miles, on 14 Mc. At this distance, tilting usually increased the signal about two S points. The signal seemed to be little affected at a distance of about 1600 miles, but tilting resulted in a decrease in strength at greater distances. Several stations have reported increased signal strength at distant points (greater than 5000 miles) by dipping the beam below the horizontal about five degrees or so, but the writer has been unable to notice this effect with the present set-up.

A duplicate of the beam was used at VP1WB in British Honduras, and he also had excellent results with it. — *Dawkins Espey, W5CXH.*

—•••—

OPERATING A HALF-WAVE DOUBLET AT THE SECOND HARMONIC

FIG. 607 shows an effective arrangement which we used at W4GNQ for operating a half-wave doublet with low-impedance feed line at the second harmonic. All it requires is the addition of a single-wire feeder, insulated from the antenna and spaced from the low-impedance line by means of standard spacers. At the fundamental, the additional feeder is idle and the system performs in the usual manner as shown at (A). To operate the system at the second harmonic, the two conductors of the low-impedance line are connected together to form one side of an open-wire line as shown at (B). If the line and the added feeder are one-quarter wavelength long, no tuning apparatus will be required. With longer lengths, series or parallel tuning should be used, depending upon the length of the line. — *Eugene Black, W2ESO–ex-W4GNQ.*

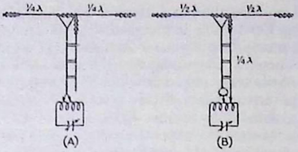


Fig. 607 — Scheme used by W2ESO for working a doublet antenna at the second harmonic. (A) shows the conventional arrangement for use on the fundamental while (B) shows the added feeder for harmonic operation.

—•••—

TUNING INDICATOR

THOSE who have low-range d.c. milliammeters but lack r.f. ammeters will find this idea, contributed by Norman Bush, VE3KW, of interest. It uses the aforesaid d.c. meter in combination with a tube and a few spare parts to provide comparative indications of r.f. flowing in the feeders.

The circuit diagram is given in Fig. 608. Note that the filament of the tube (any type which will work on fairly low filament current) is clipped across a short length of feeder. The rectified current, therefore, depends to a considerable extent on the filament temperature as well as upon the difference in r.f. potential between one end of the filament and the diode element consisting of grid and plate tied together. The chokes and by-pass are for the purpose of keeping r.f. out of the meter; VE3KW also found the resistors indicated to be necessary to prevent overheating of the chokes. The arrangement has worked out to be quite a sensitive indicating instrument for tuning purposes.

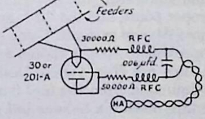


Fig. 608 — An r.f. current indicator using a vacuum-tube rectifier and a d.c. milliammeter. A 0-1 ma. meter will be most sensitive, although larger sizes may be used. With instruments of greater range, a "B" battery may be needed to increase the sensitivity.

The most pronounced change in meter reading for a small change in feeder current will occur when the filament is somewhat below normal operating temperature. The spread between the clips attaching to the feeder preferably should be such that the maximum current will cause the filament to come up to approximately normal temperature. Naturally, the spread will depend upon the type of tube used and the magnitude of the feeder current, and must be determined by experiment.

KINKS IN FEEDING ROTATABLE ANTENNAS FOR CONTINUOUS ROTATION

Many amateurs are in search of some new ideas in feeding rotatable antennas which would permit continuous rotation. These little details usually cause the most head-scratching and brain-racking.

Robert Murray of Long Island City, N. Y., and Winfred Lowe of New Brunswick, N. J., say that it's often hard to avoid wobble in a rotating shaft carrying sliding contacts for feeder connections between the stationary and moving portions of the antenna structure, particularly if the entire mast rotates. The slip-rings and brushes commonly used do not always give satisfactory contact. To overcome this, Mr. Lowe suggests the use of relatively wide disks as the movable contacts which are pinched between pairs of sliding spring contacts as shown in Fig. 609-A. Good contact is provided in spite of reasonable wobble in any direction. The stationary contacts may be made up in the form of laminations of phosphor-bronze strips. Mr. Murray's idea, shown at (B), is essentially the same except that his movable contacts are in the form of wide metal bands with the edges in a vertical plane. He claims that vertical surfaces are less susceptible to accumulations of ice or dirt. Mr. Murray suggests that spring battery clips would make good contacts if the points of the teeth are filed down.

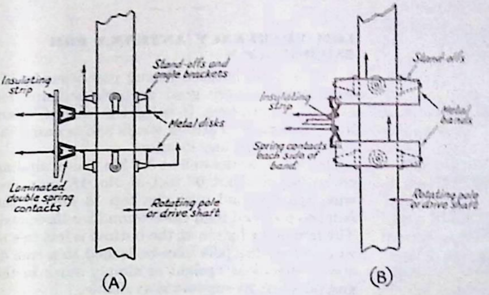

Insulating strip
Stand-offs and angle brackets
Metal disks
Laminated double spring contacts
Rotating pole or drive shaft
(A)
Stand-offs
Insulating strip
Metal bands
Spring contacts each side of band
Rotating pole or drive shaft
(B)

Fig. 609 — **New ideas in sliding contacts for rotatable antenna feeder connection to permit continuous rotation. The broad bearing surfaces take care of any wobble in the rotating mast or driving shaft.**

W3GHW of Philadelphia avoids the use of any form of sliding contact by mounting a feeder tuning unit on the rotating pole and link-coupling the antenna tank circuit to the transmission line as shown in Fig. 610. Series or parallel tuning will be used depending upon the length of the feeders between the antenna tuning unit and the antenna. The link winding is held in place by supports extended from the ground or a stationary platform. It would seem that the practicability of winding the coils about the pole would be limited to wooden poles of small diameter. The sheltering hood is fastened to the pole so that it rotates with the pole. Feed-through insulators are fitted in the top of the hood and any space between the hood and the pole should be plugged to make the hood water-tight on top.

W9AYH of Louisville has another idea, the chief disadvantage of which is that the idea is applicable to vertical antenna elements only. The antenna-system arrangement is quite similar to that described by W2BSF and W2AJF in *QST* for March, 1938, and is shown in Fig. 611. The antenna remains stationary while the reflector and director rotate about it. Thus the problem of making contact between a stationary line and a rotating antenna does not exist.

The novel feature of the W9AYH design is that the pole itself is of metal pipe and a portion of it is made to serve as the antenna. A one-quarter wavelength "J" matching section is fastened to the pipe three-quarters of a wavelength down from the top; the first half wavelength from the top forms the antenna. Since the bottom of the "J" section is at ground potential, the fact that the pipe mast is set in the ground makes no difference. In fact, good lightning protection is automatically provided. The top end of the "J" section is fastened to the mast with a stand-off insulator to provide rigidity.

The "J" section may be fed with a 600-ohm open line or a low-impedance cable and its length adjusted until standing waves disappear from the line.

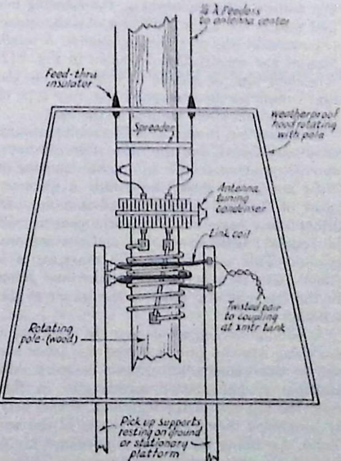

¼ λ Feeders to antenna center
Feed-thru insulator
weatherproof hood rotating with pole
Spreader
Antenna tuning condenser
Link coil
Twisted pair to coupling at xmtr tank
Rotating pole-(wood)
Pick up supports resting on ground or stationary platform

Fig. 610 — **One method of transmission line-antenna system coupling which eliminates sliding contacts. The low-impedance line is link-coupled to a tuned line.**

The rotating director and reflector are supported by arms fastened to a section of larger-diameter pipe which slides over the mast and is set in bearings at top and bottom.

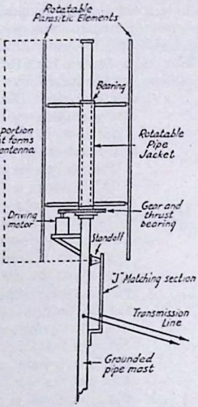


Fig. 611 — A vertical system in which a portion of the grounded pipe mast forms the stationary antenna, eliminating the necessity for feeding a movable element. The director and reflector rotate about the antenna.

Henry Riesmeyer of New Kensington, Pa., had an idea which, while it doesn't solve the problem of contact between stationary and rotating members, has interesting possibilities in feeding a low-impedance antenna. A section (or more than one section) of pipe serves as the rotating mast and also as the outer conductor of a concentric transmission line or matching section. A rough idea of the construction is shown in Fig. 612. A second pipe or section of tubing inside the first completes the concentric line. Any type of sliding contact could be used at the base.

If the section is used as a 72-ohm line it may be of any length, but the ratio of *inside* diameter of outer conductor to *outside* diameter of inner conductor should be 3.32:1. A diameter ratio of 3:1 will produce a 66-ohm line. In either case, some matching arrangement will be required between the line and the antenna system. This may consist, for example, of a tuned tank circuit with two links, one going to the line and the other to the center of the antenna.

A similar arrangement may be used as a matching section, provided that the pipes are cut to one-quarter wavelength or some odd multiple of one-quarter wavelength. In this case, the top end of the matching section may be connected directly at the center of the antenna. Assuming an antenna impedance of 15 ohms for a two-element system and a 72-ohm transmission line between transmitter and the lower end of the matching section, the ratio of diameters should be 1.72 to 1. If the impedance at the center of a three-element antenna system is 7 ohms and a 72-ohm transmission line is used, the ratio should be 1.46 to 1. If a 600-ohm line is used instead of the 72-ohm line, the ratios should be 4.87 and 2.95 to 1, respectively, for antenna impedances of 15 and 7 ohms. The problem of support and insulation of the central conductor should not be insurmountable. In all probability, a short tower support fitted with a bearing, would be necessary.

—…—

LOW-FREQUENCY ANTENNA FOR EMERGENCIES

A LONG bamboo fishing pole wound with wire makes a very good portable antenna for emergency purposes. It is light in weight, offers little resistance to strong winds and is easily installed in almost any location.

One which works well at 3.5 Mc. has a winding consisting of about 60 feet of No. 18 enameled wire, space-wound over the top 14 feet of the bamboo pole and then close-wound for three feet. The remaining length at the bottom is left free of wire so that the pole may be lashed to a tree or other convenient upright or simply stuck in the ground when no support is available.

The bottom end of the wire is connected through an antenna tuner to ground. Such a radiator seems to be much more effective than one would suppose. One of our stations in Southern California has worked the East Coast on 4-Mc. 'phone with only 40 watts input, while using an antenna of this type. — *Vernon C. Edgar, W6CRF.*

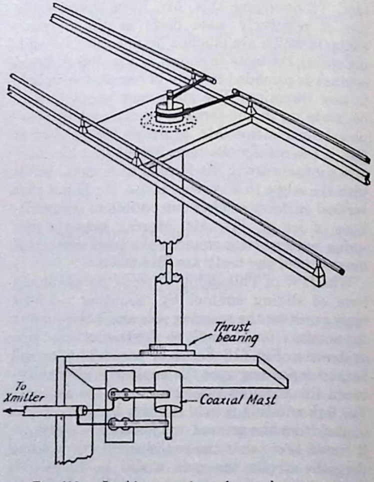


Fig. 612 — In this mounting scheme the rotating pipe mast serves also as the outer conductor of a concentric transmission line used as a matching section.

AN INEXPENSIVE 50-FOOT MAST

Back in 1937 I built a 50-foot mast which has withstood weather so well that I feel that constructional details would be of interest to others. The type of construction shown in Fig. 613 has the advantage that the mast is extremely strong, although light enough in weight to make erection easy. Material for the mast should be obtainable for about $10, plus or minus, depending upon where you happen to live in respect to lumber country.

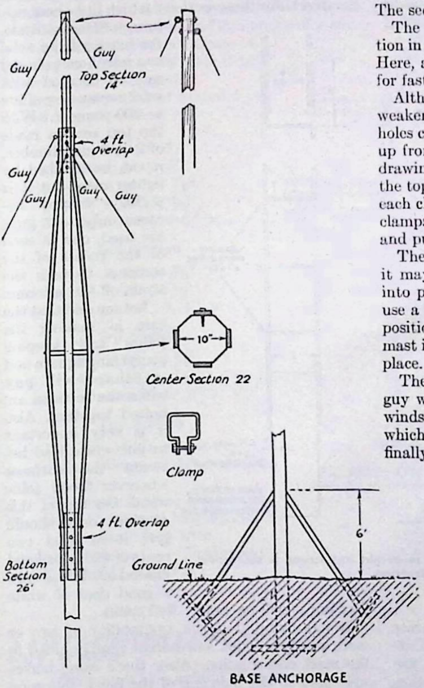


Fig. 613 — W6PGB's 50-foot mast which may be built for about $10. The martingale section at the center combines strength and light weight.

The bottom section is a 26-foot "six by six" of selected Douglas fir. The center section is the part which differs from the usual types of construction. Four 22-foot strips of 1¼ × 3-inch spruce stock are used to form a martingale structure. The four strips are spread at the center by an octagonal piece (or square piece if you don't want to bother to cut off the corners) 2 inches thick and measuring 10 inches across. The strips are fastened to this piece with lag screws.

The top section is made up of two pieces of 1¼ × 3-inch spruce bolted together with ¼-inch bolts. Eye bolts should be used at the top for fastening guy wires and pulleys.

Before assembling, each of the pieces should be given three or four coats of good lead and oil paint. The center section is bolted to the bottom section with ⅜-inch carriage bolts 9 inches long with large malleable iron washers at each end. The sections should overlap 4 feet.

The top section is fastened to the center section in a similar manner with an overlap of 4 feet. Here, also, some of the bolts should be eye bolts for fastening guy wires.

Although it has not been found necessary weakening of the joints by the drilling of bolt holes could be avoided by the use of clamps made up from heavy iron strap as shown in the detail drawing. Two of these clamps could be used at the top and bottom of each joint, the open end of each clamp facing in a different direction. Similar clamps could be used for fastening the guy wires and pulley.

The mast is sufficiently rigid and light so that it may be assembled on the ground and raised into position in one piece. The easiest way is to use a 20-foot gin pole and pull the mast up into position with block and tackle. After raising, the mast is plumbed up and the bottom braces set in place.

The mast was used for over two years with no guy wires at all and stood up well under severe winds which blew down two "A"-frame towers which had three sets of guy wires. Guys were finally used on this mast to prevent the top from swaying in heavy winds.

I believe it would be practical to extend the height of the mast to 70 feet by the addition of a second martingale section, if desired. The added length would, however, increase the raising difficulties and require an additional set of guys. — *Rex Reinhart, W6PGB.*

A LIGHTWEIGHT HOLLOW MAST

The writer believes that the following description fits the ham's wish for an ideal antenna mast. The pole was erected in 1921 when the writer was ADM of Illinois and is located in Hoopeston, Ill., where up to a few years ago it was still standing, straight and true, though somewhat in need of paint. The cost of materials for the mast, white lead and guy wire was about $10. It was sold for $5 when I left Hoopeston in 1924 and was still standing in 1937, in the yard of the ham who purchased it. Its appearance and life have been so remarkable that I believe I built better than I realized, so I feel that I am really passing along a good and worth-while suggestion.

The principle of the thing is to create a square hollow pole, held together in the fashion of bamboo growth; that is, with a bracing and strengthening section spaced about every 2 feet. The essential details are shown in Fig. 614.

The lower section of the mast is naturally the larger. Its foundation is a good and solid 6 × 6 timber about 6 feet long. The next step is to make a section about 14 to 16 or 18 feet long, depending upon the availability of the lumber which should be good, smooth finish, hard pine, cypress or spruce, depending upon the locality. Needless to say, good grain, free from knots, is desirable. Three pieces (assuming that 18-foot stock is available) are laid out. There will be two sides 6 inches by 18 feet long of ¾-inch or ⅞-inch stock, and the third will overlap on the edges so that it will be 8 inches × 18 feet × ¾ inch or ⅞ inch. Insert the "six by six" about two feet into the U formed by the three pieces above mentioned. After lining up so that all edges are flush, commence to fasten together with nails, or preferably iron screws with flat heads, not forgetting to paint thoroughly every edge with a nice thick mixture of white lead and linseed oil.

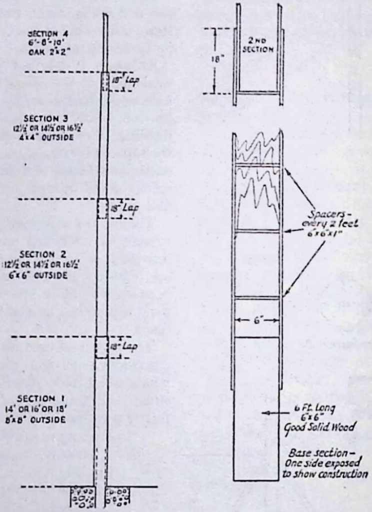


Fig. 614 — Light in weight but strong is this novel mast of hollow construction.

Having completed this step we should have a U section of mast 8 × 6 inches, 18 feet long with a 4-foot section of "six by six" as a base, which later will be embedded in concrete when we are finally erecting the mast. The next operation is to put in the braces every two feet. These are 6 × 6 × 1 inch thick. These should be put in with white lead between wood surfaces and thoroughly fastened with screws or finishing nails. At the open end of the U we leave 18 inches for insertion of the next section of the mast, which telescopes into the base section. Give the inside a thorough coat of white lead and linseed oil about the consistency of glue and let dry for a week or so. The cover for this section of the U is another piece ¾ × 8 inches, 18 feet long which is screwed down after the second coat of white lead and linseed oil is dry. Any irregularities in the lumber and joints should be smoothed down with a plane.

The second and third sections of the mast are constructed in a fashion similar to that of the base, except that they are progressively smaller and that there is no need for a solid inner base section in the upper sections of the mast. We can see that the second section should have outside dimensions of 6 × 6 inches to telescope inside the base section and that the third section will be 4 × 4 inches to telescope into the second and that the top section is a solid piece 2 × 2 inches of say 12 to 20 feet length. Our sky hook will be in the vicinity of 50 to 60 feet high, depending upon the length of lumber available.

If a 50-footer is all that is desired, an attempt should be made to obtain 18-foot lumber for all sections. The third section should be capped or plugged, instead of being filled, with a section of timber 2 × 2 inches, 20 feet long (hardwood imperative). For three sections, which just about approach 50 feet altitude, the mast will be solid as a telephone pole and can be climbed with safety even if you are a 200-pounder. With the top section made of 2 × 2 inch lumber, it can be climbed by lighter men, but it is slightly "whippy" because only four guys are used, one in each of the points of the compass to take the strain off the antenna.

Let me add that the care in making the joints and keeping everything square and shipshape will pay when the sections are bolted together. Also it is very important to put white lead between the surfaces wherever wood joins wood. On top of this caution one should give it at least two coats of white lead and linseed oil. It will take a good deal of white lead but it will be money well spent.

It was found that the availability of two or more sturdy wooden saw-horses greatly aided in the mast construction. Also, these same horses were used in the painting of the mast, following its assembly. A level area was cleared and the mast laid out with three horses supporting its length. It then was easy to paint the mast without danger of smearing the job before it was dry.

Following the painting but during the long period of waiting for the paint and lead to dry, the guy wires were rigged and the pulley and halyard installed.

Erection of this mast is child's play for a fellow who can "tote" a man's share. About three huskies are all that are needed for pure "pusha-pusha" under a pair of "two by fours" bolted together like a pair of scissors. A hole is first dug for the base of the mast about 4 feet deep and with enough space around it to pour some good "grout" concrete. In the direction in which the mast lies, a slanting runway about the width of the mast and as deep as the bottom of the pit where it is finally to rest should be dug. The 6 × 6 inch butt is eased down this runway to the bottom of the pit which throws the top of the mast to about a 15 to 20 degree angle. Then the three huskies put the "two by four" scissors-like piece under the second section of the mast and "Heave ho! my hearties." The hardest part about building this mast is waiting for the white lead and linseed to dry. After two coats inside and out and roundabout, you will find it in your coffee and your pajamas and other unexpected places, but fifteen years later it will have been about forgotten.

The complete list of material required is given below:

1st Section

1 — 6″ × 6″ × 6′
2 — 6″ × 18′ × ⅞″
2 — 8″ × 18′ × ⅞″
7 — Spacers 6″ × 6″ × 1″

2nd Section

2 — 4″ × 18′ × ⅞″
2 — 6″ × 18′ × ⅞″
8 — Spacers 4″ × 4″ × 1″

3rd Section

2 — 2″ × 18′ × ⅞″
2 — 4″ × 18′ × ⅞″
8 — Spacers 2″ × 2″ × 1″

Top Section

1 — 2″ × 2″ × 20′ — oak
1 — Pulley (Brass or bronze) (See p. 78)
1 — (Necessary length) Manila rope
4 — Guys (necessary length) No. 8 galvanized iron wire
Strain insulators.

— *Nathaniel C. Smith, W2GZU-W9UJ.*

* * *

A FIFTY-FOOTER USING NO GUY WIRES

THE mast here at W9LM was put up at a cost of no more than $8. Only four persons were needed to put it up and no guy wires were used. It has stood four years through some strong winds, too. The drawings of Figs. 615 and 616 will help to make the details clear.

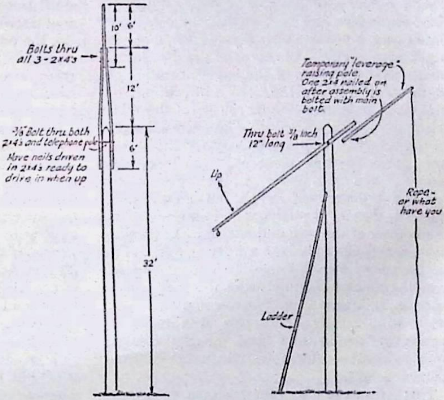

10'
6'
Bolts thru all 3-2x4's
12'
3/8" Bolt thru both 2x4's and telephone pole
Have nails driven in 2x4's ready to drive in when up
6'
32'
Temporary leverage raising pole
One 2x4 nailed on after assembly is bolted with main bolt
Thru bolt 3/8 inch 12" long
Up
Rope - or what have you?
Ladder

Fig. 615 — This type may be carried to a height of fifty feet or more. No guy wires are required.

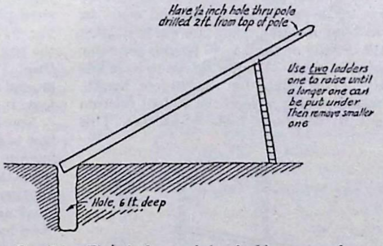

Have ½ inch hole thru pole drilled 2 ft. from top of pole
Use two ladders one to raise until a longer one can be put under Then remove smaller one
Hole, 6 ft. deep

Fig. 616 — The telephone pole is raised by means of one or more ladders, as shown. A trench or slot, dug outward from the hole towards the direction of the ladder, will aid in handling the pole in the early stages of its upward progress.

A used telephone pole was purchased and delivered for $5. That wasn't a special discount either. It was 38 feet long. A hole 6 feet deep was dug for it. This left about 32 feet above ground. About 2 feet from the top of the pole a half-inch hole was bored. The raising was done by hand until a ladder could be placed under it. Two ladders were used. After the pole was raised with a short ladder (about 12 feet long), another one about 20 feet was used to raise it up all the way.

The top section was assembled on the ground. Three "two by fours" were needed, two 18 feet long and one 10 feet long. The 10-foot section was placed between the two others and bolted in place so that the total length was 24 feet. The assembly also required a half-inch hole to receive the main bolt which is ⅜-inch diameter, about 12 to 14 inches long. This half-inch hole was drilled about 5 feet from the ends of the two long pieces. The long pieces were spread so that the "two by fours" would go on each side of the telephone pole, and the long bolt inserted. Three or four nails were driven in one side of one long length to nail it on the telephone pole when it is up straight.

In order to obtain leverage to swing this top part into an upright position, a temporary piece of "two by four" was nailed to the other long piece on one side. A rope was fastened on the end so that someone on the ground could swing the whole top section up in the air. This temporary raising apparatus should be in good condition to prevent the thing from coming back down with a bang. — *C. Falstrom, W9LM.*

AN EASY WAY TO RAISE A MAST

Since assistance in mast raising is often lacking, others might like to know how a 60-foot pole was raised at W6QXK by one person, *unassisted*. The general method, discovered by accident, is so simple that it has probably been used in many instances, but perhaps some may not have thought of it.

It was discovered when an attempt was being made to raise a 37-foot pole by sliding it up a 10-foot stepladder, top first, so that the pole would be in such a position that it could be pulled upright with a guy. The center of gravity had already passed the top of the ladder, creating the problem of keeping the base down while continuing to slide the pole over the top of the ladder without too much friction. The eventual result of this was that the pole got away and the bottom shot up as the pole pivoted on the top of the ladder. When the pole finally hit the ground, the top was on the ground and the bottom was sticking up in the air. The halyard had tangled around the bottom of the pole and the end was hanging down far enough to be reached. By merely pulling the base down with this rope, the pole was pivoted into the desired position using the ladder as a fulcrum, making it an easy matter to pull the pole erect with a guy. This pole was made of sections of "two by three" and, though it creaked some and bent considerably, it did not break from its own weight.

This job was so easy that it was thought that, with a fulcrum twice as high, a pole twice as tall could be raised in the same manner. Of course the strain on the mast at the fulcrum would be much greater for a taller pole. In order to see if a 60-foot pole made of the same material could be raised without breaking, the strain was calculated using the density of wood as 40 pounds per cubic foot (actually about 35, but it is best to have lots of safety). This strain for the 40-foot length, which would project beyond the 20-foot fulcrum came out to be about 1500 lb.-wt.-feet. This was applied to a small section of "two by three" (150-lb. boy 10 feet from fulcrum). The result showed that some sort of bracing was necessary. Since there were many odd pieces of lumber available, it was decided that the pole should be made strong enough around the point of support so that it would not break of its own weight. This was accomplished by adding lengths of "two by three" and "two by two" as bracing until the pole was strong enough. The strength was tested with each additional bracing by hanging the pole on a short stepladder at the desired point of support. To be strong enough to support its own weight the pole had to have the thickness of three sticks around the point of support and two sticks halfway up and one stick at the top.

After painting the pole and bracing the joints with bands of No. 12 galvanized wire, the guy wires were put on. Three guy posts were used, each with three wires. One set of wires was 25 feet from the ground, the next 40 feet, and the top set was fastened at the end of the pole. The guys were No. 12 galvanized wire, broken every 12 feet with insulators. The guy posts were each 30 feet from the base of the pole. The length of the wires was calculated fairly closely so that there would not be too much slack while the pole was being raised. The fulcrum was a 20-foot "four by five." The top of this fulcrum was fitted with an arrangement something like that shown at (4) Fig. 617-A. In this particular case, a double roller-skate wheel with a guide made of "one by two" was nailed to the top of the fulcrum, to allow the pole to slide as easily as possible. To prevent the pole from sliding too far when being raised, a chock was nailed to the pole at the desired pivot point, 21 feet from the base (see (3) Fig. 617-B.) The fulcrum was raised 6 feet from the peg which marked the desired position of the base. This peg was sunk about 3 feet into the ground and protruded above the ground another foot. It was essential to the raising of the pole.

Now came the biggest problem of all — that of how to get the base of the pole onto the top of the fulcrum. The pole was quite heavy and, in spite of the thickness around the fulcrum, quite limber. Another factor was that the pole was very apt to break near the top, where there was only a single "two by three," if it were supported only at its two ends. These problems were solved by erecting another 20-foot "four by five," about 12 feet from the fulcrum in line with the fulcrum, peg and guy post. This "crane" had a pulley arrangement with the pole as shown at (1), Fig. 617-A. To raise the pole to the fulcrum, it was hoisted slowly by the pulley arrangement. As it was being raised, the top end was braced with a 4-foot stepladder which was constantly moved back to keep the pole fairly straight. When the end was brought near the top of the fulcrum, it was guided with a 20-foot piece of "two by two."

After the end was securely on top, the pole was pushed from the far end until the hoisting pulley on the pole was even with the fulcrum. The hoisting rope was pulled through the pulley with the aid of a long stick. When this operation was com-

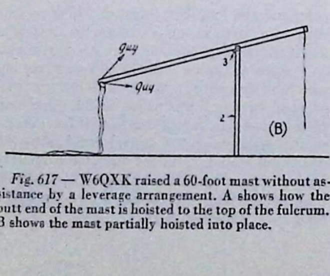


Fig. 617 — W6QXK raised a 60-foot mast without assistance by a leverage arrangement. A shows how the butt end of the mast is hoisted to the top of the fulcrum. B shows the mast partially hoisted into place.

pleted, the pole was pushed the rest of the way until the chock hit the skate wheel. The lifting crane was now taken out of the way, and two sets of guy wires were tied off. Then the base of the pole was pulled down toward the base peg. Because of uneven ground, the base hit about 2 feet from where it was intended, but it was lashed firmly in place with a rope around the peg. All that was left was to pull the pole into place with the unfastened set of guys. By fastening a long rope to the top guy and another to the middle one and getting off about 50 feet or so, the pole was pulled up with very little difficulty. After the pole was straightened a bit, the base was moved over to the peg by merely lifting and pushing.

The only equipment needed to raise poles up to about 40 feet by this scheme is a 10-foot stepladder. — *Bill Snyder, W6QXK.*

—···—

MAST-RAISING KINK

IN THE various mast-raising schemes suggested from time to time, we often see a ladder put to use, usually as a sort of gin pole. In erecting a mast of moderate height made of light material, such as the popular "A"-type mast made of "two by two," the ladder often can be used to advantage in the manner shown in Fig. 618. Here the ladder is used to prop up the mast to keep it from bending to the breaking point when it is pulled up with the guy wires. The ladder, rather than the mast itself is "ginned" up. Of course, careful timing between those handling the gin pole and those pulling on the guy wires is required, but I have put up a 50-foot stick in half an hour without any trouble. It is essential that the part extending beyond the ladder be kept bent up by proper tension of the guys. — *Robert Hidley, W2JAW.*

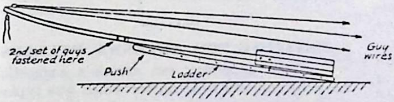


Fig. 618 — This is how W2JAW uses a ladder to brace a light mast while it is being erected.

—···—

FEEDER TUNING

FIG. 619 shows a rearrangement of the usual series-parallel feeder-tuning system which will often help when it is found that the parallel condenser doesn't have quite enough spacing and arcs over.

With the antenna coil plugged in at *A*, we have the usual circuit which is still used for series tuning. When the antenna coil is plugged in at *B*, however, the series condensers are now connected in series with the parallel condenser to decrease the voltage across the latter. The extent of the reduction in voltage across the parallel condenser will depend upon the setting of the series condensers. When each of their capacities is the same as that of the parallal condenser, the total voltage across the coil will divide equally, so that only one third of the voltage will appear across the parallel condenser.

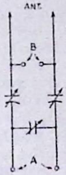


Fig. 619 — W3FEG's arrangement for feeder tuning. Series tuning is obtained with the antenna coil plugged in at *A*, and parallel tuning with the coil plugged in at *B*.

Of course, it may not be possible to reduce the voltage to this extent, because the series condensers usually have smaller spacing than the parallel condenser and, therefore, will arc over more readily. Nevertheless, many cases will be found where the reduction is sufficient to make operation possible without buying a higher-voltage condenser.

In practice, it is usually possible to find a fixed setting for the series condensers for each band, so that all tuning may be done with the parallel condenser once the series condensers have been set. — *Edward R. Hill, W3FEG.*

—···—

DRIP WIRES FOR ANTENNA FEEDERS

WHEN antenna feeders approach the window at a fairly low angle, rain has a tendency to follow the wires to the lead-through insulators before dripping off. Unless the joints are waterproofed, the rain may even penetrate the feed-through. In winter this results in a pile of ice on the window sill and around the lead-through insulators. The feeders of my station enter the top of the window through insulators at such an angle that the wires carry a lot of water to the window where it drips down onto the window sill and splashes badly against the glass.

To remedy this, I made drip wires as shown in Fig. 620. They consist of short pieces of copper wire pinched on the feeders a short distance out from the window. These "drip wires" drain off all the water that runs down along the feeders, eliminating the nuisance of water dripping on the window sill as well as ice formation in the winter. — *Robert E. Foltz, W9GBT.*

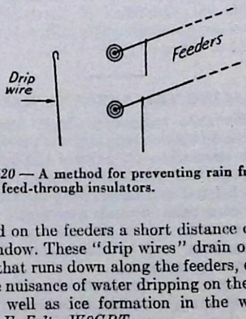


Fig. 620 — A method for preventing rain from dripping off feed-through insulators.

INFORMATION ON PULLEYS

Nearly every person interested in radio is confronted, at some time, with the problem of the type of pulley best suited to antenna erection. In most antenna installations the pulley is so situated that it remains for weeks exposed to all weather conditions. In many cases the halyard remains in one position and failure to exercise the pulley results in "freezing." The results of tests with five common types should prove valuable to many readers. We are indebted to D. Reginald Tibbets, W6ITH, for this data compiled before World War II.

The five pulleys, all placed in use under the same conditions, were:

1) Ordinary cheap galvanized iron awning pulley; cost, 10¢.
2) Better grade galvanized iron with bronze shaft; cost, 25¢.
3) Bronze awning pulley, boat supply; cost, 65¢.
4) Hardwood block with steel shaft; cost, 90¢.
5) Hardwood block with bronze roller bearing shaft; cost, $1.50.

(Note. — All prices prewar.)

After several months of use, winter and spring, the test yielded the following comparison of the different types:

1) This pulley was completely out of operation. It had "frozen" within two months.
2) This pulley could be turned, but corrosion which had taken place on the inside face of the pulley caused binding.
3) The bronze awning pulley could be turned, but it showed some stiffness as a result of corrosion. This type was considered to be a satisfactory one for the purpose, if cleaned periodically; however, the usual inaccessible position of the antenna pulley makes this impractical.
4) The hardwood block pulley with steel shaft was inoperative, owing to rusting of the steel shaft which caused the latter to "freeze" in the block bearings.
5) The fifth type, hardwood block with bronze roller-bearing shaft, was found best suited to this use. Operation of the pulley under test compared favorably with that of a new one of the same type.

REPLACING THE ANTENNA HALYARD

Several suggestions have been made from time to time on replacing the pulley on the antenna mast when the halyard breaks. One of the most popular schemes is to rig up a new pulley and halyard and fasten the pulley to a loop of wire or a band of strap iron which may be slipped over the top of the mast or, if no obstructions exist, may be bent around the mast and slipped up to the top.

Quite frequently, however, when the loop is made large enough to slide up or down the pole readily, there is nothing to hold it in position when the desired point is reached. The sketch of Fig. 621 shows a scheme which VE4KN has used successfully to overcome this difficulty. The loop is fitted with a triangular steel spur which pierces the mast and prevents the pulley from sliding down. If it becomes necessary to replace the halyard again, the spur may be released by an upward push with a stick.

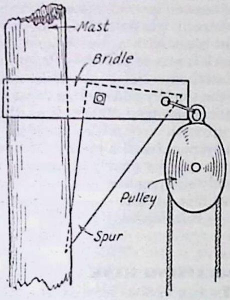


Fig. 621 — Spur suggested by VE4KN to prevent the replacement pulley from sliding down the mast.

SUBSTITUTE FOR ANTENNA PULLEYS

We recently ran across a suggestion made by the late Fred Sutter which was typical of his desire to simplify ham radio.

Knowing the difficulty with which broken antenna halyards are replaced in the usual pulley at the top of the mast, he asked, "Why use a pulley?" A rope rides about as easily over the gadget shown in Fig. 622 as it does through a pulley with the usual antenna load. If the rope breaks, there is a fair chance that a fellow with a good arm can succeed in throwing a weighted line up over the top of the mast, after a little practice. The line can be used to haul the new halyards into place.

If a strong arm is lacking, a kite or balloon with a light line may be flown near the top of the mast and maneuvered into a position which will permit dropping the line into the yoke.

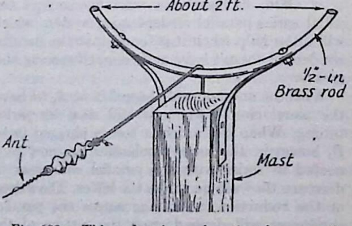


Fig. 622 — This gadget is much easier than a pulley to "rethread" when the rope breaks.

SCHEMES FOR REPLACING BROKEN ANTENNA HALYARDS ON MASTS

This problem is almost as old as amateur radio itself. If you have been wondering how to replace that broken halyard on your 60-footer without risking your neck, at least one of these solutions should make it easy. If you don't have such a problem at the present time, it would be a good idea to save this dope for a rainy day. The scheme which will best fit your particular problem will depend upon location and construction of the mast, surrounding objects and the material to which you may have access.

In most cases, it will be a much simpler job to replace the old pulley rather than to attempt to thread new rope through the old pulley, although this may often be done without great difficulty. Several schemes make use of the top guy wires in coaxing a new pulley, fitted with a new halyard, to the top of the mast. If you have a second mast or can make use of a tree or housetop or temporarily erected support, the scheme shown in Fig. 623-A is probably one of the easiest to execute. One of the top guys is set free. The new pulley with halyard is fitted with a heavy metal ring or a loop of several turns of heavy wire and the loose end of the guy wire is passed through this loop. The loop should be large enough to pass easily over the guy-wire insulators. A light cord is tied to the loop and the free end of the guy wire is tied to the halyard from the second support, hoisted up and pulled tight. It should then be possible to make the loop slide along the guy wire towards the top of the mast by shaking the new halyard and pulling on the assister cord from a distance. In some cases, it may be possible to coax the loop up over the top of the mast if one has sufficient patience and the top guys are not fastened too far from the top of the mast, although this isn't necessary. When the loop has been worked up close to the mast, it may be held there by the assister cord while the guy wire is lowered. While holding the free end of the guy wire, several turns about the mast should be made by walking around the mast outside all other guys. This will bind the loop securely to the mast. A sharp yank will break the assister cord after the job is finished.

Another scheme which may be tried is shown in Fig. 623-B. A loop of wire, as previously described, is passed around the rear top guy wire. If the loop is covered with tape or a section of old bicycle tire or garden hose, it may slide more readily on the guy wire. The new halyard and the halyard from the second support are tied together and a large slip-knot is tied in the other side of the new halyard to prevent the new halyard from running through the pulley when it is pulled up the guy. Alternatively, the two ends of the new halyard may be tied together and then tied to the halyard from the second support. An assister cord tied to the wire loop might be helpful in getting the loop over insulators; shaking the guy wire should also help. When the pulley reaches the top of the mast, the guy wire is wrapped around the top of the mast as previously described. A sharp yank on the free end of the new halyard will take the slip-knot out. It might be a good idea to tie some sort of weight between the two halyards to make sure that they will fall to the ground when released.

If you can't make use of a second support, there are other ways of doing the job. Take, for example, the idea shown in Fig. 623-C. Pass a heavy rope around the outside of all top guy wires.

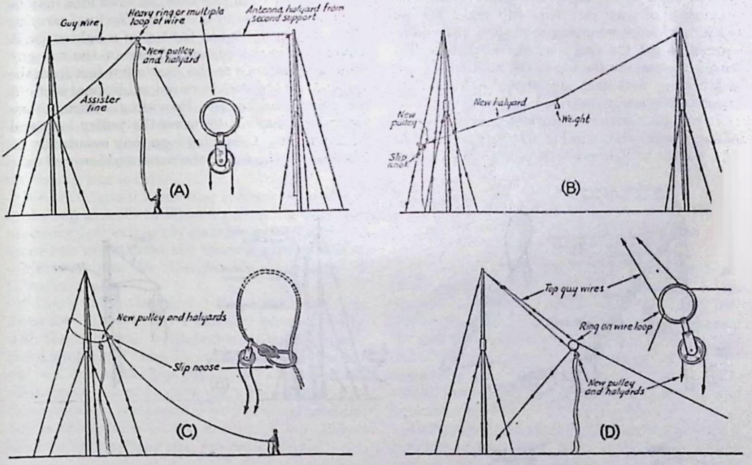


Fig. 623 — Various schemes for replacing broken antenna halyards.

Then pass the rope through the eye of the new pulley fitted with the new halyard and form a slip noose. By shaking and pulling the rope, it should be possible to work the loop up the guy wires to the top. Best results will be obtained by working the rope at a fairly good distance. If the loop becomes caught on an insulator, a friend can assist by sliding the pulley along the loop to a point near the insulator and whipping the halyard. When the noose reaches the top of the mast, its rope should be made fast to the base of the antenna.

In the scheme shown in Fig. 623-D, the ring to which the new pulley is attached should be as smooth as possible and fairly heavy. Two top guys are loosened and the ends are passed through the ring. By pulling the guy wires in as nearly opposite directions as possible, the ring will be forced towards the top of the mast. Temporary extension of each guy wire will make the job easier and some whipping or shaking may be required to get the ring over the insulators. The ring is fastened to the top of the mast by making a few turns with each guy about the top of the mast as previously described.

If you don't wish to disturb the guy wires, one of the schemes shown in Fig. 624 may be used. At (A), a series of light sticks is used to push a loop carrying the new pulley up along one of the top guy wires. The loop should be large enough to pass easily over the top of the pole. The side of the loop opposite the pulley is stapled to the end of the first stick and the loop is held in an approximately vertical position by means of a piece of light string. Each section of stick is fitted with loops of wire passing around the guy wire, the loops of sufficient size to pass easily over the guy-wire insulators. These loops should be spaced about every 3 or 4 feet. Lines or cords about 3 feet long carrying weights are attached near the top end of each section. These are to hold the stick steady on the top side of the guy wire. As the assembly is pushed up along the guy wire, additional sections are added, splicing them together with wire so that there is very little play between sections. When the loop has been maneuvered into a proper position, a sharp pull on the halyard will break the holding cord and bring the loop down over the top of the mast. Another pull on the sticks should pull out the staples holding the loop to the sticks and the pusher may then be removed and disassembled.

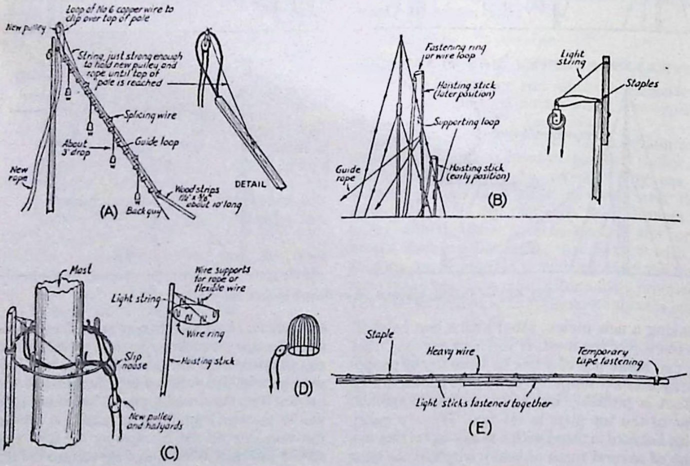

Loop of No 6 copper wire to clip over top of pole
New pulley
String, just strong enough to hold new pulley and rope until top of pole is reached
Splicing wire
Guide loop
About 3' drop
New rope
Wood strips 1½" x 5/16" about 10' long
Back guy
(A)
DETAIL
Fastening ring or wire loop
Hoisting stick (later position)
Supporting loop
Guide rope
Hoisting stick (early position)
(B)
Light string
Staples
Mast
Slip noose
New pulley and halyards
(C)
Wire supports for rope or flexible wire
Light string
Wire ring
Hoisting stick
(D)
Staple
Heavy wire
Temporary tape fastening
Light sticks fastened together
(E)

Fig. 624 — Additional ideas for replacing broken antenna halyards.

Sometimes the top guy wires are fastened some distance down on the mast so that it would be impossible to pass the loop over the top of the mast by this scheme. In this case, another idea may be used. It is shown in Fig. 624-B. The loop carrying the pulley is stapled to the top of a light stick. A guide loop is passed around one of the top guy wires and fastened to the stick a few feet from the top end. As the stick is raised, additional sections are spliced on rigidly. Providing sufficient distance has been left between the pulley loop and the guide loop, the pulley loop may eventually be lifted above the top of the mast and lowered over it. If the weight of the halyard is too great for the strength of the hoisting stick, light cord may be substituted temporarily during the hoisting process and replaced with the halyard when the pulley is in place. Guide cords attached at points along the stick and operated by a friend may help to keep the stick from buckling and to maneuver the loop over the end of the pole. It may help some in getting over the insulators to release the guy wire and bring it into a more nearly vertical position near the mast. If the diameter of the pole does not vary too greatly between top and bottom, a similar series of sticks might be fitted with larger guide loops encircling the mast itself instead of the guy wire.

The details of a scheme which may be used where no guy wires or only a set of guys at the top of the mast interfere are shown in Fig. 624-C. A stiff ring which encircles the mast is fitted with a series of wire hooks bent as shown in the drawing. This ring is attached to a section of light stick by means of staples or light cord. A slip-noose of heavy rope or flexible wire to which the pulley is fastened rests above the ring supported by the wire hooks. Braces made of string keep the loop or ring at right angles to the hoisting stick. The ring with the noose is then pushed up the pole, adding sections of stick as required. If the stick starts to bend, it may be supported by attaching additional loops of wire at points along the stick. When the loop has been pushed to the top of the mast, a jerk on the halyard will tighten the noose about the pole and then the hoisting stick may be lowered. Should the noose have a tendency to loosen up and slide down the pole, this may be prevented by soaking the noose in varnish or some other adhesive which will bind the noose to the mast when it dries.

We think you'll agree that the risk of climbing to the top of a 50- or 60-foot pole is not only unnecessary but extremely hazardous. If you don't agree you might read the following letter on the subject, written by Douglas A. Parsonage of Grimsby, Ont.

"Don't climb the mast. I had a 65-footer with three sets of guys and I had the same difficulty with the halyards. I climbed my mast but came down a lot faster than I went up. When I reached the top, one of the top guys broke and I and the mast came down. It gave me a nice vacation of three weeks in the hospital with a spinal fracture. So, as the 'Voice of Experience,' I say, '*Don't climb it. Do anything else, but don't climb it.*'"

* * *

PUTTING THE ANTENNA BACK ON THE POLE

If an antenna halyard breaks, or if the pulley fastening breaks, the unfortunate ham is usually confronted with a big problem. At VE5DG, with the ground frozen and all the rigging fallen to the ground, prospects looked none too pleasant to the operator upon his return after a long absence. The poles were too tall and slender to be climbed, and the condition of the ground was added to the usual obstacles against taking down the poles. Suggestions from sympathetic friends ranged from kites to monkeys trained for such jobs, but none of these was considered practical.

After much searching a method for replacement of the rigging was found. With the necessary materials gathered together at a pole, less than twenty minutes were required for the complete operation.

A few 1 × 2 inch pieces of wood are used to carry rigging to the top of the pole. A hole is bored through the upper end of the first piece, and through it is passed a short length of stiff wire which is then bent to form a loose circle about the lower portion of the pole. Three hooks bent from soft copper wire and suspended from this hoop support a slip rope snare in which is placed the new pulley. Short pieces of wire are tied between the stiff wire hoop and a point on the stick a few inches above it, to carry the weight of the slip noose and insure that the hoop remains horizontal throughout the climb to the top of the antenna pole.

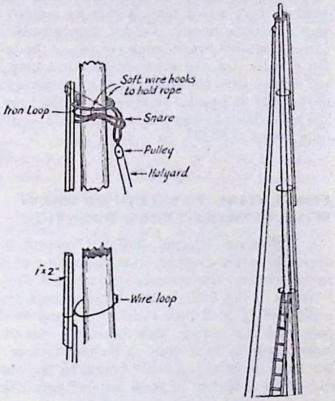


Fig. 625 — Details of the method used by VE5DG for replacing antenna pulley and halyard.

This assembly is then pushed up the pole by a member of the crew on a long ladder leaned against the pole, and the top of a second piece is then nailed to the bottom of the first. At this joint is fastened a second loop of wire around the pole, and the operation is repeated.

A sketch of the arrangement of the rigging at the top of the first stick is shown in Fig. 625. The completed assembly raised to the top of the pole also is diagrammed.

The tackle is sent up the pole "one by two" length, ladder high, at each step in the process. Particular care is exercised to prevent enthusiasm from allowing the loop to be pushed past the top of the pole. As insurance against such a calamity, it is desirable that someone view the closing operations from a point some distance from the bottom of the pole, since it is possible to be deceived by viewing the top of the pole from directly beneath.

When the top loop has reached the proper point near the top of the pole, a pull simultaneously applied to the two ends of the rope through the pulley is used to straighten out the soft wire hooks supporting the noose, and to tighten the noose on the top of the pole.

When the pulley is in place at the top of the pole, the sticks are lowered in steps and taken apart, and are then ready for similar use elsewhere by another unlucky ham.

Although the pole on which this method was used is unguyed, it may readily be applied to guyed systems as well. The top guys provide insurance against overrunning the top of the pole. On a calm day the intermediate guys may be unfastened from the stakes (if the pole is reasonably rigid) and pulled tight down to the base of the pole while the new rigging is run up. — *William Lowry, VE5DG.*

—···—

PREVENTING TANGLING OF OPEN-WIRE FEEDERS UNDER ROTATION

Harold Ulmer, W6EPM, describes a device he worked out to prevent tangling of the feeder wires as the antenna is rotated. A sketch is shown in Fig. 626. An iron bracket made from a piece of ¼ × 2 inch strip is fastened to the pole with lag screws. This bracket is about 9 inches long on each side. A U-shaped piece of the same material is loosely bolted to the outer end of the bracket to form a joint permitting horizontal motion. One side of a large hinge is bolted to the U-shaped piece, and to the other end a 3½-foot length of "one by four" is fastened. This arm is fitted with a pair of stand-off insulators to which the feeders are attached. The bracket is fastened about halfway up the antenna mast.

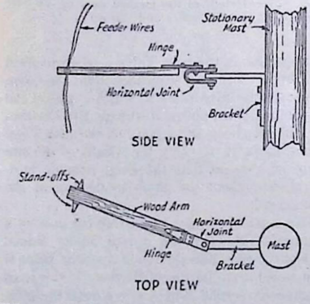


Fig. 626 — Sketch of the arrangement used by W6EPM to prevent tangling of open-wire feeders when used with a rotatable antenna.

Now, as the antenna is rotated, the arm will swing around the mast to the point where the arm is stopped by the mast. When the antenna is turned the last few degrees to complete the rotation the hinge comes into play. The arm rises in an upward direction, which serves to release any strain which may be imposed on the antenna feeders.

INSULATED MOUNTING FOR ROTATABLE ANTENNA ELEMENTS

For those fellows making rotary beams and using ¾-inch or 1-inch diameter tubing for elements, here is a suggestion for providing support that is stronger than the use of stand-off insulators. This idea is shown in Fig. 627.

The hose clamp (stainless steel strap that fits around tubing) can be obtained from the Wittek Manufacturing Co. in Chicago at a cost of five cents each. Order them without the wing bolt, style No. 3. [Note. — Prewar price and type number.]

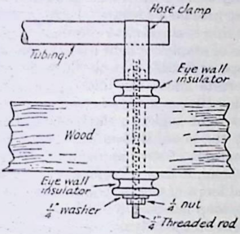


Fig. 627 — A substitute for stand-off insulators in supporting rotatable antenna elements which provides a mounting of greater mechanical strength.

The porcelain-eye wall insulators sell for about two cents each at most radio supply houses. Remove the galvanized screw with a heavy screwdriver.

The porcelain tubes cost about 2½ cents for 6-inch lengths. Nick each of them with a file and insert in the wood framework (5/16-inch diameter hole) then break. You will get a clean square break this way and it's a lot easier than sawing. It is a good plan to boil the porcelain tubes in paraffin unless they are of the glazed type.

A threaded rod ¼ inch in diameter completes the assembly with a standard ¼-inch washer and ¼-inch square nut which may be obtained at any hardware store. The length of threaded rod depends on the thickness of the wood.

This procedure results in a good substantial mounting, well insulated and a lot stronger than stand-offs. — *Edward E. Schultz, Jr., W9UHA.*

—···—

TENSION FOR BUILDING SPACED FEEDERS

It is always a headache to pull up a pair of long wires and to hold them even in length and in tension when building spaced feeders. I have hitched one end of the wires to a solid support and the other end to the front bumper of the family car. By backing the car slowly, the wires can be pulled tight and even. When they look about right, the brake is set. The line is then ready for attaching the spreaders. If you're inclined to have a heavy toe on the gas pedal, however, take it easy. — *Owen Shepherd, Jr., W1IJ.*

PROTECTION AGAINST DAMAGE BY LIGHTNING

This hint deals with practical systems providing protection to the ham station and adjacent property against damage by lightning. We haven't much of an idea as to how many amateur installations are struck by lightning in the course of a year, but if the number is small, it is probably due to good luck more than anything else since protection is one of the last things the average ham considers. It is a rather absurd situation since a few simple precautions will render the installation impervious to almost anything except a direct stroke of the antenna and will also reduce the probability of even this.

The usual radio antenna will not survive a direct stroke. The current in some cases may be as high as 200,000 amperes which usually results in melting of the antenna wire and the creation of some other path to ground. Fortunately, however, direct strokes are comparatively rare except in unusually exposed locations. Indirect strokes are more frequent and are capable of doing serious damage unless precautions are taken. If an antenna is connected to a good ground, the danger of a stroke in the immediate vicinity of the antenna is considerably reduced. The charge between a cloud and the antenna is drawn off as rapidly as it is developed and only when the charge develops more rapidly than it can be discharged through the resistance of the antenna and ground system will there be great danger of a direct stroke.

Several methods of antenna grounding are suggested. The use of a grounding switch is obvious, but is not automatic and the operator often forgets or neglects to close the switch upon closing the station down. A direct ground connection also will take care of snow-static discharges which are often bothersome in northern latitudes. An arrangement which permits permanent grounding of the antenna system is shown in Fig. 628. The feeders are connected directly to ground through r.f. chokes. Balanced antenna systems fed at the center should not require the r.f. chokes unless series tuning is necessary; the center point of the antenna tank coil or coupling coil may be grounded directly.

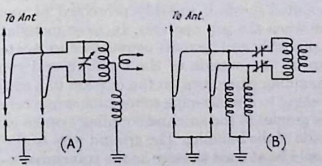


Fig. 628 — Two methods for grounding antennas to reduce the danger from lightning.

In the case of an unbalanced system such as the familiar Zepp-type antenna, however, it is probable that the r.f. choke at the center of the coil will be required in most cases, since a voltage node seldom occurs at the center of the feeder system unless the antenna is carefully cut for and used at one frequency.

To take care of rapidly rising charges which might not be dissipated sufficiently fast through the chokes, ground gaps are provided for each feeder wire. These gaps should be made as small as possible without breaking down under normal operation of the transmitter. In connecting to the gaps, the feeders should be bent at a rather sharp angle. Such a bend, or a turn or two of heavy conductor between the gap and the antenna tuning equipment, will provide an impedance for a steep wave-front surge, thus encouraging a discharge through the gap rather than through the transmitter. Once the gap breaks down, its resistance becomes very low. Several gap designs are shown in Figs. 629 and 630.

A very simple type of electrode and mounting is shown in Fig. 629-A. This is suggested by W8OSL. Rubber cones, cut from an old inner tube and slipped over the upper electrodes, protect the gap against short-circuit by snow or rain. In this case the electrodes are made of pieces of heavy wire.

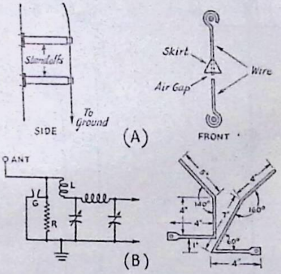


Fig. 629 — Two gap suggestions. (A) shows the arrangement for mounting the gap suggested by W8OSL, while (B) shows the details of W4AAQ's gap.

W4AAQ recommends the arrangement shown in Fig. 629-B for Marconi-type antennas frequently used in 160-meter work.

"*L* is a two-turn coil of copper tubing or heavy wire, self-supporting, four inches in diameter. This coil has sufficient inductance to offer a high impedance to the steep wave-front of lightning surges and causes them to take the path of least resistance through the gap to ground. The resistance *R* is of the order of 200,000 ohms and is effective in draining small static charges to ground before they have an opportunity to build up a potential sufficient to break down the gap." (Unless a noninductive resistance is obtainable, an r.f. choke should be connected above the resistor. — Editor.)

Although a pi-section filter is shown in the diagram, the system may be used with other forms of coupling.

The construction of the gap is shown in the detail drawing. It may be made from one-quarter-inch copper tubing or No. 2 or No. 4 wire.

The one at Fig. 630-A is suggested by W1ALJ. The gap is made from three pieces of copper tubing, bent as shown and mounted on stand-off insulators. The side of the building upon which the gap is mounted is protected against possible danger of fire, when the gap operates, by an asbestos-board mounting. (Insulation of the ground wire is not required by fire underwriters. — EDITOR)

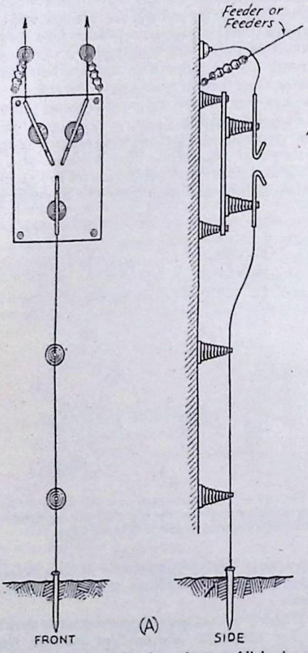
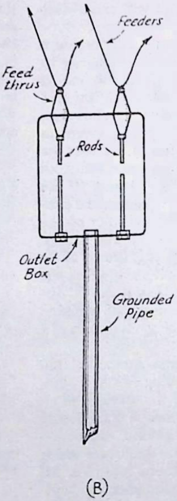


Fig. 630 — An enclosed weather-proof lightning gap mounted in an outlet box.

An enclosed gap is suggested by Robert Murray of Long Island City, N. Y. It is shown in Fig. 630-B and consists of a pair of gaps mounted in a steel outlet box. The box is mounted on a section of galvanized iron pipe driven well into the ground or bonded to a good ground. The contacts between the pipe and box and between the lower electrodes of the gap and the box should be as firm and of as low resistance as possible. The upper gap electrodes are mounted on feed-through insulators to provide good transmission-line insulation. The electrodes may be made from ¼-inch diameter rod.

Grounds and Ground Wires

In considering protective measures against lightning, it might be well to review the subject of grounds and ground wires. Any protective system is only as good as its ground connection. The National Board of Fire Underwriters recommends the use of a connection to a water-pipe system wherever such is available at not too great a distance from the antenna lead-in point. Other permissible grounds are grounded steel frames of buildings or other grounded metal work in the building.



Where a water pipe or other suitable ground connection is not available, an artificial ground may be made with driven pipes, buried plates, etc. If the soil is dry, several rods or pipes spaced three or four feet should be used. These should be driven as deep as practicable into the ground and connected together below the surface of the ground. A coil of wire, or metal plate submerged in a well, makes a good ground connection. If the well is some distance from the lead-in point, connection should be made to a driven-pipe ground immediately under the lead-in point before continuing to the well ground. In very dry locations, it would be advisable to create an area of permanent moisture around the ground rods or pipes by frequent application of salt water.

The ground wire need not be insulated from the building, but it should be protected against possible mechanical injury. It is permissible to run the wire to ground inside the building if this will shorten the path to ground. The lightning arrester also may be mounted inside if suitably protected to prevent fire when the gap operates. In most installations it probably will be most convenient to locate the gap on the outside of the building and run its grounding wire down on the outside to a suitable opening to a water-pipe connection while running the ground to the antenna coupling system on the inside of the building. The ground wire to the gap should be at least as large as the transmission-line wires combined and in no case should it be less than No. 14 wire.

—…—

The most positive protection is to *ground* the antenna system when it is not in use. Grounded flexible wires provided with clips for connection may be used, or the old reliable "lightning-switch" may be installed. In any case, the ground lead should be short and should run as directly as possible to a good ground. Avoid sharp bends in any lightning protection system for best results.

7. *Hints and Kinks . . .* for V.H.F. Gear

A SIMPLE BATTERY-POWERED 112-MC. TRANSCEIVER

ALMOST every ham has his pet circuit. Being experimentally inclined, I spent considerable time recently in trying one transceiver arrangement after another. Perhaps some of the other fellows might be interested in the one that has worked out best for me against all others I have tried. The circuit is shown in Fig. 701. It does not stray far from the conventional, but it has been found possible to simplify somewhat the usual change-over system.

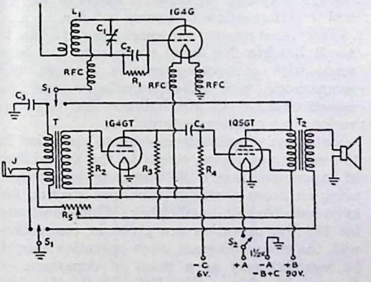


Fig. 701 — Circuit diagram of W9EMQ's simplified 112-Mc. battery-powered transceiver.

C_1 — Two-plate variable condenser (Hammarlund MC-type with all but one rotor and one stator removed).
C_2 — 100-μμfd. mica.
C_3 — 0.002-μfd. paper.
C_4 — 0.01-μfd. paper.
J — Microphone jack.
L — 6 turns No. 14, center-tapped, 3/16-inch diameter, 1¼ inch long.
R_1 — 1 megohm, ½-watt.
R_2, R_3 — 50,000 ohms.
R_4 — 0.25 megohm, ½-watt.
R_5 — 50,000-ohm potentiometer with on-off switch (S2).
S_1 — Sections of d.p.d.t. toggle switch.
S_2 — See R_5 above.
T_1 — Transceiver transformer.
T_2 — Speaker transformer.

A 1G4GT first audio feeds a 1Q5GT power output tube. The primary of the speaker transformer is used as a modulation choke when the plate-supply lead is switched to the plate of the 1Q5GT. Battery bias is applied to both audio stages, holding the "B"-battery drain to a low value. The three tubes draw only 10 ma. when receiving and 13 ma. when transmitting. Numerous arrangements were tried to eliminate the microphone battery, the one shown finally being adopted.

The 1G4G oscillator tube is changed over from a superregenerative detector to a power oscillator simply by disconnecting the low-frequency plate by-pass condenser, C_3. No change is made in the value or method of connection of the grid leak. Smaller values of grid leak connected from grid to ground on "transmit" gave no appreciable increase either in input or output, and the necessity for an additional set of contacts on the switch and some trouble in making the receiver "super" because of the extra leads were entirely avoided. This is a little different from the usual transceiver, but it really works fine business — as a test will soon prove.

The important points of construction are shown in the sketch of Fig. 702. The unit, together with batteries, is housed in a standard steel case, 15 × 7¾ × 7 inches, with a handle attached at the top. Only the upper portion of the panel is shown in the sketch. The batteries occupy the lower portion of the case. A hole is cut for the 3-

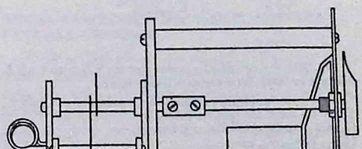


Fig. 702 — Sketch showing layout and essential constructional points of W9EMQ's transceiver.

inch permanent-magnet speaker which is mounted directly behind the panel.

The r.f. circuit components are mounted on a small Presdwood subpanel, approximately 3 × 5 inches, spaced from the front panel by sections of wood dowel. This subpanel is mounted on the left side of the front panel. To avoid socket losses, a hole to fit the base of the tube is cut in the subpanel and the tube is cemented in place. After all, it shouldn't be necessary to change the tube every five minutes! Before mounting, the base of the tube is scored between pins with a hacksaw. All tube connections are made by soldering directly to the tube pins. The tube should be placed so that the plate terminal is in the upper left-hand corner, directly below one stator terminal of the two-plate variable condenser. This should permit a plate lead one-half inch long. The grid lead is only the length of the grid condenser. An insulated shaft is used between the condenser rotor and the control on the front panel.

The audio-circuit components are wired together in a compact harness before they are mounted along the right-hand edge of the front panel. The change-over switch is a d.p.d.t. toggle switch mounted in the center of the panel below the speaker. — *H. Gordon Gwinn, W9EMQ.*

……

A V.H.F. AND U.H.F. CONVERTER USING A CRYSTAL DETECTOR

AN EXPERIMENTAL converter for reception on the very-high and ultrahigh frequencies is shown in Fig. 703.

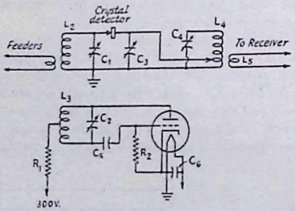


Fig. 703 — Circuit of a converter for v.h.f. and u.h.f. using a crystal detector as a diode mixer.

C_1 — 3-plate midget variable (approximately 5 μμfd.).
C_2 — 15-μμfd. midget variable.
C_3, C_4 — 3–30-μμfd. mica trimmer.
C_5 — 100-μμfd. mica.
C_6 — 500-μμfd. mica.
R_1 — 20,000 ohms, 1-watt.
R_2 — 0.25 megohm, ½-watt.
L_1 — 1 turn No. 14, ½-inch diameter.
L_2 — 5 turns No. 14, ½-inch diameter, turns spaced slightly more than diameter of wire.
L_3 — 4 turns No. 12, ½-inch diameter, ½-inch winding length.
L_4, L_5 — I.f. transformer for chosen input frequency on the receiver to be used.

A crystal rectifier is employed as a diode mixer. Crystal detectors are commonly used in ultrahigh-frequency work, since they will function at frequencies where the transit-time effect present in an ordinary diode or other vacuum-tube detector would result in impaired operation.

The oscillator tube may be a 7A4 if the converter is to be used only for reception in the 112-Mc. band. However, since interest in the experimental development of higher frequencies is a prime consideration in the design of the converter, a 955 acorn triode should be used as the h.f. oscillator if one is available.

Coupling between the oscillator and detector coils should be very loose. A spacing of about 2 inches gave ample injection voltage. In fact, a spacing of 6 inches worked almost as well. If the coupling is made too tight, signal levels drop and the noise level rises.

A tendency toward superregeneration in the oscillator was cured by omitting the usual r.f. choke in the plate circuit and substituting the 20,000-ohm resistor shown in the circuit diagram.

The crystal-rectifier output is tapped down on the i.f. transformer coil, the tap being located about one turn from the ground end.

Output from the converter may be fed into the front end of any sensitive receiver capable of tuning to 28 Mc. or higher. In our case the receiver was a 7-tube superheterodyne, using tubes of the 6D6 vintage and built some years ago for 56-Mc. reception. Its input is tuned to 40 Mc. and the intermediate frequency is 5 Mc.

Tests have covered the range from 112 Mc. to about 150 Mc. No direct comparison has been made with a superregenerative receiver, but comparisons with other superheterodyne receivers used on 112 Mc. indicate that this converter gives superior performance.

Extension of amateur interest to operation in the microwave region points to the desirability of experimentation with this receiving circuit, using an acorn oscillator tube and striving for every possible gain in efficiency. While constants for 112-Mc. operation are given in connection with the circuit diagram, such operation should be regarded only as a point of departure. — *Bernard W. Bates, W1BBM, North Harwich, Mass.*

……

SIMPLE TONE MODULATION FOR V.H.F. TRANSMITTERS

C. B. SEIBERT, W8SPY/TDJ, describes a simple system of tone modulation which he used with his v.h.f. transmitter.

The circuit diagram is shown in Fig. 704. A relaxation oscillator employing a neon bulb is used

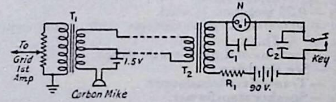


Fig. 704 — Arrangement for using a neon-bulb oscillator for tone modulation.

C_1 — 0.003-μfd. paper.
C_2 — 0.01-μfd. paper.
R_1 — 0.5 megohm, ½-watt.
N — Neon pilot lamp No. 5122.
T_1 — Double-button carbon microphone input transformer in existing speech amplifier.
T_2 — Single-button carbon microphone transformer, operated as step-down transformer.

as the tone source. This is coupled into the first audio tube of the modulator via the microphone transformer. The most convenient feature of the arrangement is that no switching is necessary to select either voice or tone input.

The oscillator is one which has been used for some time as a code-practice set with a pair of magnetic headphones in place of T_2. While standard neon glow lamps of the one-half or one-quarter-watt variety may be used, the values of C_1 and R_1 may have to be changed somewhat to obtain the desired tone. The resistor found in the base of the lamp should be removed.

SIMPLE V.H.F. TANK CIRCUIT FROM SALVAGED MATERIAL

An article on page 15 of the September, 1942, issue of *QST* suggested an added economy in the design of a tank circuit. The tank coil is made from an old coil shield. Opposite sides are clipped out, leaving a U-shaped segment, as shown in Fig. 705. If the shield is of rectangular shape, the curved corners are retained to provide strength. In any case some of the side is left near the closed end. Cylindrical shields provided with a separable bottom mounting offer an added advantage.

Small pieces of mica are inserted between the bottom ends of the "coil" and the friction mounting, constituting a tank condenser. Resonance may be adjusted roughly by inserting more or thicker pieces of mica. To preserve electrical balance, the same thickness of mica should be used on both sides. Finer adjustment may be secured by sliding the "coil" section up or down on the insulated mounting.

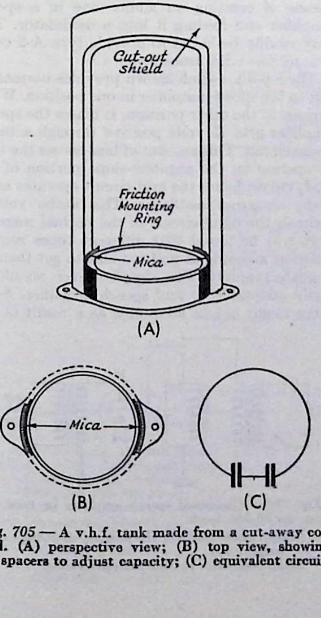


Fig. 705 — **A v.h.f. tank made from a cut-away coil shield. (A) perspective view; (B) top view, showing mica spacers to adjust capacity; (C) equivalent circuit.**

A short piece of bakelite tubing of the proper diameter to make a sliding fit with the shield "coil" may be substituted for the friction mounting if it is covered with thin copper or shim brass. The tube socket is mounted concentrically with the tank assembly to provide short grid and plate leads. The high-voltage lead is taken off the center or closed end of the "coil," opposite the tube. Experiment will determine whether a particular tube will operate best with the cathode grounded. A tab of shim brass and a small piece of mica may be used as a grid condenser. Any conventional circuit can be employed.

No dimensions are offered, as the material available will govern the constants of the circuit. After an assembly is constructed of whatever is at hand and placed in operation, the resonant frequency should be measured by Lecher wires or other means. The tank then may be trimmed in the proper direction to reach the desired frequency. Average-sized or large shields will resonate in the neighborhood of 56 Mc., while smaller shields may be trimmed to resonate in the 112-Mc. band.

No low-loss insulation is required except in the tube socket. A rubber band may be used to hold the ends of the "coil" firmly against the mounting ring. — *Charles A. Moore, K7LO.*

REMOVING LOKTAL BASES

Better performance at the higher frequencies may be obtained from loktal tubes, such as the 7A4, if the metal band at the base is removed. This can be easily done if the tube is boiled in water until the cement between the band and the tube has become softened. The ring then can be removed with a pair of gas pliers. — *Fred Craven, W8ERV.*

NOISE LIMITER FOR V.H.F. MOBILE INSTALLATIONS

Fig. 706 shows the diagram of a very successful noise-silencing circuit I used with my automobile radio receiver in conjunction with a Browning v.h.f. converter. Ignition interference from my own car had been cut considerably by the use of the usual condenser and suppressor precautions, but there was still enough noise left to bother me — especially when no signal was present, as in the case of police-station reception. The ignition interference caused by other cars near by was terrific, becoming nothing less than bedlam in heavy traffic.

The circuit suggested by W9ZWW in *QST* for March, 1940, was tried, but since it was designed to be most effective during signal reception, noise was still bad when no signal was present. Knowing of the effective noise silencer used by Hallicrafters in their S-27 v.h.f. a.m.-f.m. receiver, an adaptation of this circuit was worked out for inclusion in the automobile receiver. Acknowledgment of the suggestions made by W9WNE is made at this time. He suggested keeping the volume control out of the limiter bias circuit and also supplied the circuit used for the volume-control isolation.

With the noise-limiter tube in the circuit no ignition noise is heard from my own car at any time, signal or no signal. Ignition noise will appear under conditions of extreme saturation by other unshielded or unsuppressed automobile engines, but on the whole this limiter has been most satisfactory. It is possible to cruise in the city with the volume at a satisfactory level for signal reception and yet not have bothersome ignition noise when the signal is off the air. This limiter is preferred to a noise squelching circuit, both because of the greater ease of installation in the receiver and its better sensitivity to weak signals in general.

No noticeable effect on the quality of either voice or music reception has been experienced when the noise limiter is in the circuit. — *Paul M. Cornell, W8EFW.*

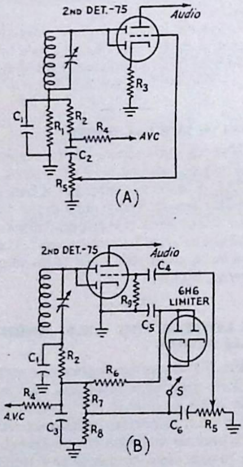


Fig. 706 — **W8EFW's noise-limiter circuit for mobile receivers using v.h.f. converters. (A) shows original connections in the b.c. receiver, while the alterations required are shown at (B).**

C_1, C_3 — 50-μμfd. mica.
C_2 — 0.01-μfd. paper.
C_4, C_6 — 0.005-μfd. mica.
C_5 — 0.05-μfd. paper.
R_1 — 250,000 ohms, ½-watt.
R_2 — 50,000 ohms, ½-watt.
R_3 — 250 ohms, 1-watt.
R_4, R_6 — 1 megohm, ½-watt.
R_5 — 500,000-ohm potentiometer.
R_7 — 40,000 ohms, ½-watt.
R_8 — 150,000 ohms, ½-watt.
R_9 — 10 megohms, ½-watt.

SUBSTITUTE CIRCUIT FOR TRANSCEIVER TRANSFORMER

Fig. 707 shows an arrangement we have been using in our 2½-meter transceivers since transceiver transformers are not now obtainable. I found the substitute circuit to work very well, although the voltage step-up provided by the transformer is sacrificed. In this arrangement, the detector is simply capacity-coupled to the first speech amplifier stage following the microphone. The connection does not interfere with proper operation of the microphone circuit.

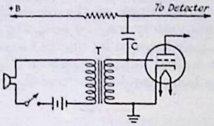


Fig. 707 — **If a transceiver transformer cannot be obtained for your WERS unit, W8AQT suggests an alternative way of connecting the detector output by resistance-capacity coupling to the speech amplifier.**
R **is a 25,000-ohm ½-watt resistor and** *C* **a 0.01-μfd. paper condenser.** *T* **is the mike transformer.**

I have also used a door-bell transformer as a substitute for a microphone transformer, with good results. — *Glenn V. Lichtenfels, W8AQT.*

—···—

SPEECH AMPLIFIER OR AUDIO OSCILLATOR FOR V.H.F. TRANSMITTER

The circuit shown in Fig. 708 provides a means of creating an audio tone in a speech amplifier and feeding it into a modulator. This may readily be keyed to provide type A-2 emission for the v.h.f. transmitter.

The s.p.d.t. switch shown provides normal input to the speech amplifier in one position. When thrown to the other position, it biases the speech amplifier grid 45 volts positive through a tuned audio circuit. This amount of bias causes the tube to operate on the negative-slope portion of the E_c-I_g curve; hence the grid circuit operates as an audio dynatron oscillator. This audio voltage controls the plate circuit in the normal manner.

It will be found that different tubes require different amounts of positive bias to get them to oscillate properly. The idea, however, should be easily adaptable to any speech amplifier. Some tubes might not be adaptable as a result of too

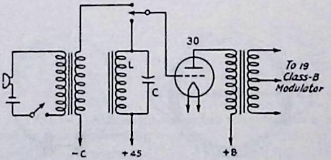


Fig. 708 — **Combined speech amplifier or tone generator for 56-Mc. work.**
L — Midget audio choke or the primary of a small audio transformer.
C — Small condenser to tune to desired tone.

high grid current under the positive bias conditions, which would, of course, damage the tube.
— *Millett G. Morgan, W8OTD.*

—···—

A TRANSMITTER-RECEIVER FOR THE 112-MC. BAND

After constructing and operating several types of 112- to 116-Mc. WERS communication units, including linear-tank transmitters with separate receivers and a number of transceiver combinations, we decided on the transmitter-receiver diagrammed in Fig. 709. This equipment does not require much power, and therefore may be operated from an auto-radio power supply or from an a.c. power pack delivering about 250 volts at 60 to 100 ma.

The general plan of this equipment was to eliminate all unnecessary controls and, at the same time, provide tuning and volume controls on the receiver that would not cause the transmitted frequency to shift about and change in percentage of modulation. These items are especially important when the equipment is to be operated by personnel having little experience.

A Type 76 tube seems to operate best in the receiver, but may be replaced by a 6J5, 7A4 or the Philco XXL. The transmitter seems to perform best with the XXL, although Types 7A4, 6J5, 6V6 triode-connected, or any similar type, will work well. In the first audio stage a 6C5 apparently works as well as the 6J5, while the 6F6, 42, or any similar power-amplifier tube may be used in place of the 6V6 in the modulator. In other words, the unit is not too critical and may be adapted to use almost any tubes that happen to be available.

The transmitter inductance and tuning condenser are mounted underneath the 7 × 9 × 2-inch chassis, and are preset to the desired frequency. The receiver volume control is switched so that it may be adjusted for any receiver volume required without affecting the transmitter modulation; also, only one control is used to accomplish the required results at this point.

The 0.006-μfd. condenser, C_5, was merely included to improve the quality of speech, and may be changed to meet operating conditions and microphone quality. The 8-μfd. condenser, C_8, was found to reduce hum and vibrator hash very noticeably in some instances, depending on the type of filter used in the power supply which was available. It may not be required in all installations. Radio-frequency chokes were constructed of 30 turns of No. 28 d.c.c. wire, ¼-inch inside diameter, and were mounted in the set so as to be self-supporting.

Because of differences in the internal capacities of tubes, capacity and inductance of wiring, etc., it may be found necessary to experiment with different vales of C_4, R_2, R_7 and R_3 to obtain proper superregeneration with as low a voltage as possible and also to eliminate undesirable feedback, squeals, etc., in the first audio stage. T_1 is an ordinary audio transformer of about 3 to 1 ratio with the addition of one layer of No. 30 to

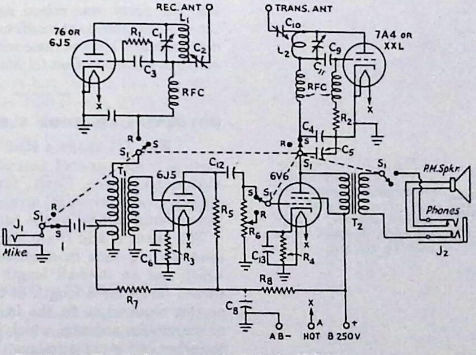


Fig. 709 — Circuit diagram of the 112-Mc. WERS transmitter-receiver.

C_1, C_9 — 7–35-μμfd. 2-plate variable.
C_2, C_{10} — 1.5–7-μμfd. air trimmer.
C_3, C_{11} — 50-μμfd. mica.
C_4, C_{12} — 0.01-μfd. 450-volt paper.
C_5, C_{13} — 0.006-μfd. 450-volt paper.
C_6 — 25-μfd. 25-volt electrolytic.
C_7 — 100-μμfd. 450-volt paper.
C_8 — 8-μfd. 450-volt electrolytic (see text).
R_1 — 5 megohms, ½-watt.
R_2 — 2000 ohms, ½-watt.
R_3 — 900 ohms, 1-watt.
R_4 — 200 ohms, 1-watt.
R_5 — 50,000 ohms, 1-watt.
R_6 — 250,000-ohm volume control.
R_7 — 25,000 ohms, 1-watt.
R_8 — 50,000 ohms, 1-watt.
L_1 — 4 turns No. 14, ⅜-inch inside diameter.
L_2 — 4 turns No. 14, ¼-inch inside diameter.
RFC — 30 turns No. 28, wound over ¼-inch diameter form.
J_1 — Single-circuit jack.
J_2 — Double-circuit jack.
S_1 — 8-pole 2-section rotary switch.
T_1 — 3:1 audio transformer with microphone winding added (see text).
T_2 — Output transformer.

No. 40 wire wound over the present windings and connected to the single-button carbon microphone. The connection for 'phones does not deliver optimum power output, but signal strength was found to be more than sufficient for headphone operation.

All power-plug connections are standardized so that any set or power supply, a.c. or d.c. vibrator pack, may be interchanged, keeping in mind that an a.c. supply having the filament winding center-tapped to ground will not work until the ground tap is opened.

The receiver works best with a long-wire antenna and is not critical when capacity-coupled as shown, while the transmitter performs best with a quarter- or half-wave rod antenna.

We were unable to obtain properly insulated parts for use at this frequency, and realize that we have considerable losses in sockets, etc., but in actual operation we found this unit to outperform some commercially built units using Type HY-75 tubes. — *L. R. Jenkins, Radio Aide, W.JZY.*

—···—

A 6-ELEMENT VERTICAL ARRAY FOR 113 MC.

I HAVE had good luck with a six-element vertical array for 113 Mc., shown in Fig. 710, which employs the principle of the extended double "Zepp." It lowers the angle of the "dome" radiation, putting it out at an angle of about 4 degrees in a pattern extending around the horizon. Consequently, the array does not need to be rotated and permits fast operating.

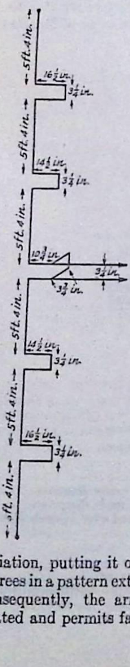


Fig. 710 — Arrangement and dimensions of a six-element stacked vertical array, using the extended double "Zepp" principle, designed to operate on 113 Mc.

The antenna is constructed of No. 12 copperweld wire. The transmission line and the matching stubs are of No. 14 copperweld wire, which is of course somewhat easier to handle than the No. 12. The copperweld wire is stiff enough so that the phasing stubs extend almost at right angles from the radiator. It is not important to have them in line with each other. They may whirl in space around the radiator, provided they remain approximately at right angles to the array.

The transmission line should extend at a right angle to the radiator for a distance of at least ten feet before making any bend. It is spaced with Johnson No. 134 feeder bars at intervals of 18 inches. Johnson No. 104 antenna insulators are used between each of the elements of the radiator at the points where the phasing stubs and the transmission line are connected.

The vertical radiator consists of six elements, each ⅝-wavelength long, and all connected by phasing stubs which are approximately 3⁄32 of a wavelength. The stubs connecting the two end elements to the array are 16½ inches long. The two next to the center elements are 14½ inches long. All are spaced 3¼ inches. The radiating elements are each 5 feet 4 inches long.

The matching stub at the center of the array is 3¾ inches long, also spaced 3¼ inches, as is the transmission line. The matching stub is connected to the feeders at a point approximately 10¾ inches from the radiator. Plus or minus ¼ inch from this point should cover the adjustment for maximum results.

My array is hung from a messenger cable between two 90-foot poles. In the preliminary testing, the array was raised and lowered several times before the exact maximum dimensions were determined. This was done with the aid of a field strength meter. — *Don C. Wallace, W6AM.*

—···—

FOLDING CAR-ROOF V.H.F. ANTENNA

FIG. 711 shows a sketch of a fitting for a vertical v.h.f. car-roof antenna which the gang around Torrington, Conn., favor because it provides a good mechanical arrangement for folding the antenna parallel to the car roof.

The pieces *A* and *B* are made from sections of brass rod ¾ inch in diameter. One end of *A*, which has an over-all length of 3½ inches, is turned down for a length of 2 inches to the diameter required to fit the inside of the bottom of the tubular antenna, which is soldered fast. At the other end is cut a tongue, 1 inch long and ¼ inch wide.

Piece *B* has an over-all length of 6 inches. One end is turned down and threaded with a ⅜-inch die, while a slot, 1 inch deep and ¼ inch wide to fit the tongue of *A*, is cut in the opposite end. The slotted end is then drilled and tapped on one side of the slot for a ¼-inch thumb screw, *C*. A vertical elongated hole is drilled and filed out in the tongue of piece *A*, so that, with the thumb screw loosened, *A* can be lifted up slightly to clear the shoulders of *B* while the antenna is being folded down. The solid seating of the two pieces when the antenna is vertical provides little opportunity for the joint to work loose.

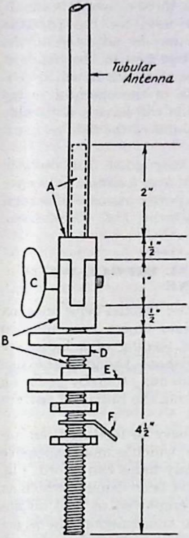


Fig. 711 — **Feed-through insulation and fittings for the folding car-roof mobile antenna. The joint hinges at C so that the antenna may be folded down parallel to the roof of the car.**

The threaded shank of piece *B* passes through a hole in the roof of the car. The polystyrene washers, *D* and *E*, provide the necessary insulation. Each is 2 inches in diameter and ¼ inch thick and has a collar or hub ¼ inch thick turned on one side to fit the hole in the car roof. The assembly is clamped to the roof by the locking nuts. *F* is a soldering lug for making the connection to the antenna.

If the assembly is placed near the forward part of the roof, the antenna may be folded back at the hinge without overhanging the rear of the car. — *Ed. Toloski, W1KXB.*

* * *

SHUNT-FED MOBILE ANTENNAS

The shunt-fed arrangement shown in Fig. 712 was first tried after I had had some difficulty with my first antenna for mobile use, which was a vertical rod on the back bumper. This was fed in the conventional manner with a concentric line, using crystal-microphone cable for the purpose, and it apparently worked well on transmitting. I later installed a relay operating from the transmitter plate voltage to throw the antenna over to the receiver. This worked well while the car was stationary, but when in motion so much static was picked up by the antenna that it was impossible to receive. It was while attempting to eliminate this that shunt feed was first tried. It was the solution insofar as static was concerned, and I have since found it superior in other respects. Perhaps this is because of a better impedance match, since there is undoubtedly some mismatch between crystal-microphone cable and the bottom of a quarter-wave antenna.

The antenna proper is an adjustable bumper-rod whip of the usual type which has an extended length of 8 feet. This can be used as either a quarter- or half-wave antenna on 56 Mc. The feeder is crystal-microphone cable, which is very reasonable in price compared to the 34-ohm concentric line necessary to match correctly the bottom of a one-quarter-wave antenna. Crystal-microphone cable has a higher impedance, but it can be well matched by shunt-feeding the antenna. For quarter-wave operation the bottom of the antenna is grounded to the car frame and the outside conductor of the feeder is grounded at both ends. At the antenna end, a copper clip is fastened to the center conductor. This clip is moved about on the antenna until the best transfer of power is accomplished. A field-strength meter will be advantageous in making this adjustment, although it will not be found too critical.

Superior results may be obtained on 56 Mc. if the antenna is run out to its full length, making it one-half-wave long. In this case, it will be necessary to insert a quarter-wave loading coil (6 turns of heavy wire, 2 inches in diameter) between the bottom end of the antenna and the car frame. The center conductor is now connected somewhere about the center portion of the loading coil. Here, again, the field-strength meter will be helpful.

In my own installation, to facilitate antenna changes, I am using copper clips on the outside end of the feeder (both inner and outer conductors) with a short flexible lead from the bottom of the antenna, and on both ends of the loading coil. — *Eric W. Cruser, W2DYR.*

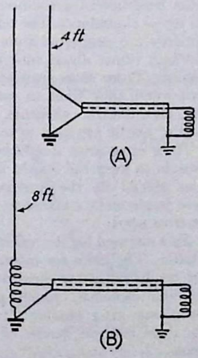


Fig. 712 — **Shunt-fed mobile antennas as used by W2DYR to reduce noise. (A) is for quarter-wave operation; (B) is for half-wave antennas.**

THREE-ELEMENT DIRECTIONAL ANTENNA FOR 112-MC. PORTABLE WORK

Fig. 713 depicts a simple directional antenna which may find application in v.h.f. work. It has been used successfully with a transceiver of conventional design employing a 1G4GT and a 1T5GT.

Wanting to try a beam antenna on 112-Mc. with a minimum of alterations, I hit on the idea of just building something I could add to the half-wave antenna already mounted on the transceiver. This antenna is a vertical ex-car antenna and is tapped at the base with threads of appropriate size to fit the hardware of a bee-hive insulator mounted on top of the cabinet. The reflector and director elements are supported from a pair of cross arms which rotate about the vertical antenna as an axis. These cross arms are made of wood, except where they come in contact with the reflector and director elements. At these points, pieces of plastic are used to improve the insulation. These cross arms should be made as light as possible to keep the weight down. The central holes should fit the antenna snugly; the telescopic joints make convenient points for locating the cross arms.

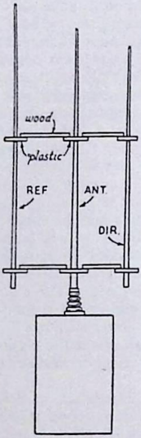


Fig. 713 — An efficient antenna for directional work with 112-Mc. band portable equipment.

Plexiglas discs are used for the reflector and director insulation. The holes for mounting these elements are made somewhat smaller than the diameter of the elements, which are forced through the plastic after heating it. After the plastic cools there is little danger of loosening of the elements.

For a frequency of 115 Mc. the antenna is 48¾ inches long, the reflector 51¼ inches long, and the director 46¾ inches long. The spacing between the antenna and the director should be 10 inches, while a spacing of 15 inches is used between the antenna and the reflector. However, these dimensions will work over a broad range, considering that it is a three-element beam. If telescopic elements are used for the parasitic elements their lengths may be adjusted on the nose for any desired frequency in the band, of course. In adjusting the elements it will be observed that the presence of the operator in the direct field of the antenna will have a noticeable effect, so he should keep out of the field as much as possible.

The antenna has a very good front-to-back ratio and it provides gain over a simple half-wave antenna equivalent to a power increase of several times. — *S/Sgt. J. H. Jearne, Det. Third Com., Hensley Field, Dallas, Tex.*

* * *

FEEDING A COAXIAL DIPOLE WITH AN OPEN-WIRE LINE

The merits of the coaxial-type antenna are well-known. The chief object accomplished with this system is the feeding of a half-wave dipole at the center without bringing the line into the field of the antenna, thereby reducing the possibility of distorting the radiation pattern of the antenna.

However, it is customary to feed such an antenna with coaxial cable, which is more expensive in long lengths than many hams can afford. Fig. 714 shows a system I have been using in which an open-wire line may be employed to feed an antenna of this type. The transmission line is designed for a characteristic impedance of very close to 400 ohms. It consists of a pair of No. 12 wires spaced 1¼ inch, separated by 2-inch spreaders in which holes with the correct spacing have been drilled.

Referring to the sketch, the rod *A* and the 3-inch-diameter cylinder A_1 are the two halves of the half-wave dipole. They must be insulated from each other. The 1-inch-diameter metal tube *B* and the No. 12 wire *C*, mounted inside A_1 make up a concentric quarter-wave section of about 160 ohms for matching the 400-ohm line to the center of the dipole. The top end of *B* is, therefore, connected electrically to the top end of A_1, while the top end of the center conductor of the matching section is connected to the bottom end of the antenna rod, *A*. The 400-ohm line is connected to the lower ends of *B* and *C*.

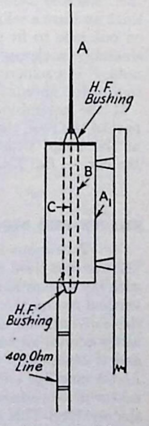


Fig. 714 — W8SR's scheme for feeding a coaxial antenna with an open-wire line. *A* and A_1 are halves of the half-wave dipole antenna, while *B* and *C* form a quarter-wave matching section.

A_1 is a 2-foot section of 3-inch round rain spouting, while B is a 2-foot section of 1-inch thin-wall electric conduit. A single National type XS-1 h.f. bushing is divided to form an insulating support at each end of B for the No. 12 wire C. The threaded rod is cut in half and each piece soldered to one end of the wire. The nuts may then be used to draw the wire up tight. The upper half of the bushing is also used to support the upper half of the antenna, A. A 3-inch ring of metal with a 1-inch hole at the center may be used to fasten the top ends of A_1 and B together. The bottom ends may be held together by a similar ring cut from polystyrene sheet, or 1-inch stand-off insulators may be used between the lower ends of A_1 and B. The whole assembly is mounted on the pole with heavy stand-off insulators. The line should be anchored to the pole to take the strain off the assembly. With the line coupled to the transmitter with a hairpin loop, this system has given very excellent results. — *H. R. Gebhardt, W8SR.*

—…—

A UNIVERSAL-ANGLE V.H.F. ANTENNA MOUNTING

The days when an electrician could build a satisfactory antenna for a radio transmitter seem to have gone out along with unrationed gasoline and Scotch whiskey. The construction crew for many a modern antenna system must include a couple of plumbers and a sheet-metal worker. After this a further complication arises. If maximum advantage is to be taken of the directional effects of such antennas, they must be steered. And the mechanism required may call for the combined services of a steam-shovel designer and an automobile mechanic.

The purpose to be served by the device here described is control of the position of the vertical plane of an antenna as well as its azimuthal rotation through all points of the compass. Since the energy taken from an electromagnetic wave by a receiving antenna will normally be greatest when the antenna polarization is the same as that of the arriving wave, it is clear that, unless we can expect the arriving wave to maintain a constant polarization, a convenient means of varying the polarization of the receiving antenna is desirable in order to avail ourselves of all possible transmitted energy. In the field of v.h.f. wave propagation the polarization of the arriving wave seldom bears any definite relation to the polarization of the transmitting antenna. Optimum adjustment of the polarization of the receiving antenna then can be determined only by experiment. The v.h.f. operator will appreciate a mounting device for his antenna which will enable him to control searching motion with the greatest possible ease.

Suppose we let the radio engineers take a back seat for a while, just asking them for a bit of advice occasionally, while we mechanics have our innings with the design of a universal-angle antenna mounting. The design of many an amateur's postwar antenna will necessarily depend largely upon what he can find in his junk box. There are probably a number of basic mechanical arrangements which will prove to be particularly suitable for mounting antennas for universal-angle motion. The one here described has been found very practical in actual use as the mounting of the writer's three-element 28-Mc. antenna. For antennas designed for higher frequencies the design should prove even more useful and workable, especially for the experimenter.

Yachtsmen and mariners will recognize in the sketch of Fig. 715 a device known as a gimbal, a traditional method of mounting a marine compass so that it will remain level despite the pitch or roll of the ship. A pair of gimbals constitute a sort of universal joint. Concentric rings, B and C, are cut from properly weatherproofed plywood or other suitable material. The dimensions will be determined by the size and weight of the antenna elements which are to be supported upon the outer ring, C. The bearings on which the outer ring pivots about the inner ring B may be short metal straps, as shown in Fig. 715, or they may simply be holes in the edge of the ring. In the latter case, for mountings intended to carry a heavy two- or three-element array, it would be an improvement to line the holes with sections of metal tubing to secure longer-wearing surfaces. The pivot pins may be short sections of metal rod or tubing, mounted tightly on the edge of ring B.

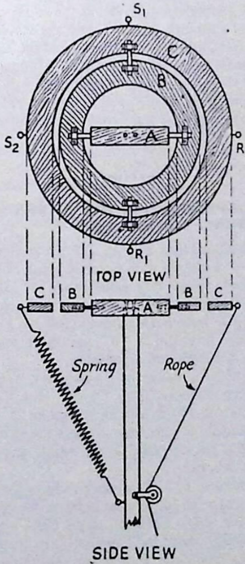


Fig. 715 — Gimbals-type mounting for universal-angle adjustment of the plane of a dipole antenna or a small directive array. Only one rope and spring are shown in the side view, although a second pair is attached at right angles to these, at points S_1 and R_1.

The assembly of outer and inner rings is pivoted about a central block, *A*, which may be a piece of hard wood mounted on top of the mast. The bearings between *A* and *B* are similar to those already described. To permit rotation of the complete assembly for horizontal directivity the central block, *A*, may be mounted so as to pivot about a vertical pin passing through a hole drilled in its center, or the block may be mounted solidly if the mast itself can be rotated. The latter plan is preferable, since it will simplify control of the rings in the gimbals. Such control can be accomplished by the very simple expedient of attaching ropes at points 90 degrees apart on the outer edge of the outer ring, opposite the axes of rotation of the two rings. Each rope pulls against a tension spring attached between the mast and a point diametrically opposite the pull of the rope. The method is illustrated in the lower detail of Fig. 715, although only the rope and spring controlling the outer ring are shown.

Various types of antennas may be mounted upon the outer ring, parallel to its plane. Since that plane can be varied about a horizontal axis the radiator, or the elements of an array, may be used as either a vertical or a horizontal antenna. The angle of the main lobe of radiation can be adjusted at will, as well as the polarization. Directional adjustment is taken care of by rotation of the mast. The writer's three-element 28-Mc. beam array was mounted on the outer ring of the gimbals, the gimbals in turn being mounted on the top end of a 20-foot topmast, and the whole topmast was rotated in bearings mounted on the ends of crossarms on a telephone pole. Motors were provided to pull the ropes as well as to rotate the topmast, and the whole system was operated by remote control from the usual station operating position. — *F. C. Beekley, W1GS.*

—···—

A COLLAPSIBLE ROTARY ANTENNA FOR 112-MC. MOBILE USE

The sketches of Fig. 716 show the construction of a simple four-element beam antenna which I have found very satisfactory for 112-Mc. mobile operation. The antenna system consists of a vertical half-wave antenna fed by a short twisted-pair line and a "J" matching section, with two directors and a reflector.

The frame is made of ½-inch by 1½-inch furring-strip material. The "mast" is a "closet pole" which is 1½ inches in diameter. A hinge near the middle of the frame permits the structure to be folded for carrying in the trunk or on the back seat of a car.

For elements, ½-inch copper tubing is the most efficient, although aluminum is more convenient for portable work because of its light weight. The elements may be snapped into place in heavy-duty fuse clips mounted on the frame with stand-off insulators, as shown at *B* and *C*. An extra clip will support the "J" section.

The antenna element is 48 inches long, while the reflector is 51 inches long and the two directors each 45 inches long. A spacing of 12½ inches is used between all elements except the antenna and reflector elements, which are spaced 25 inches.

The "J" matching section is 24 inches long and the match is adjusted by moving the low-impedance line, fitted with clips, along the section.

The "mast" may be set in a fitting near the front door of the car so that the antenna may be rotated by hand.

The outfit sure did work wonders for me last summer, and it's simple enough so that no one should have any trouble making one up. — *John Klar, W1LFI.*

—···—

SHATTER-PROOF INSULATOR FOR CONCENTRIC ANTENNAS

I used several concentric antennas on 112-Mc. portable-mobile before December 7, 1941, and, as a rule, I rolled the coaxial up in a blanket and tossed it in the back of the car. After driving to the top of some distant peak, I usually found the ceramic feed-through insulator cracked or broken. At home, the one I had on my fixed antenna, 90 feet in the air, also broke in heavy windstorms frequently.

A visit to a radio store or electrical repair shop will provide a lot of empty spools which once held magnet wire. By sawing one of these spools in half and boiling it in paraffin for about 15 minutes, we have two bushings that are well-nigh unbreakable and whose losses do not appear to be excessive. All of the spools appeared to fit snugly into one-inch conduit but the inner hole varied from ¼ inch to ⅜ inch, with the ¼-inch size predominating. — *Clyde Criswell, W6QLZ.*

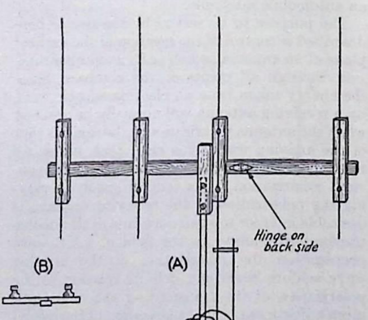


Fig. 716 — W1LFI's collapsible 112-Mc. four-element beam for mobile work. The frame is hinged, while the elements are held in position by fuse clips to make assembling and disassembling the array an easy job. (B) and (C) show the details of element mounting.

AN INEXPENSIVE MOUNTING FOR A 112-MC. ARRAY

It is not necessary to do without the advantages of a rotary beam for 112-Mc. work, if one is willing to forego one or two dispensable refinements. The four-element vertical array shown in Fig. 717 was easy to construct and cost only $2.90, including the price of a 20-foot length of ⅝-inch o.d. copper tubing. Four feet of the copper tubing remained for use in the tank circuit of the transmitter, so that the actual investment in the beam was $2.66 — prewar prices.

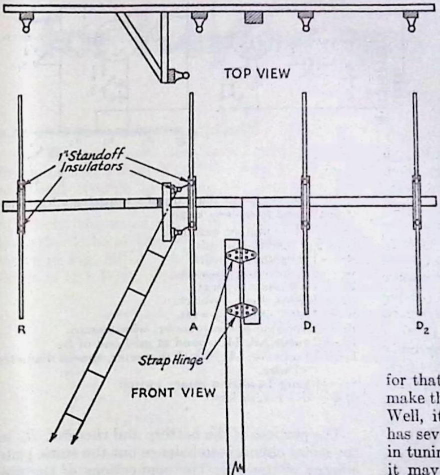


Fig. 717 — **Hinged mounting for a 112-Mc. array. The arm which supports the feed line at right angles to the cross-bar should be two feet or more in length, since its purpose is to prevent, insofar as possible, any interference with the field pattern of the antenna.**

The mast is a 16-foot length of 2 × 3. Two feet of the same stock is arranged to swing about the top two feet of the mast by means of very heavy strap hinges, about six inches in length. The cross-bar supporting the elements is of 1¾ × 1-inch stock, four feet in length. The elements of ⅝-inch copper tubing are each rigidly supported by two stand-off insulators, mounted on 2 × 12 × 1-inch strips which are fastened to the cross-bar at the proper intervals. The lengths of the elements will depend upon the desired operating frequency. In this case the radiator was 48¾ inches, the reflector 50⅞ inches, and the directors 44⅝ inches. The spacing should follow the suggestions given in *The ARRL Antenna Book.*

This scheme of rotating the array does not allow complete 360-degree rotation, but there is an advantage even in this handicap since the feeders do not have a chance to wrap themselves about the mast. The beam is rotated through a range of about 200 degrees by means of two ropes, one attached to each end of the cross-bar, which are passed through pulleys to the nearest window in the shack. Heavy grease should be applied to the hinges and the pulleys.

A 400-ohm line was used with a delta matching section measuring 12½ inches on the sides and spanning 10 inches across the center of the radiator. — *Herman Lukoff, W3HTF.*

SIMPLE METHOD FOR INVESTIGATING PERFORMANCE OF 112-MC. ANTENNAS

The adjustment of a 112-Mc. antenna for best performance usually requires not only some form of field-strength measuring device but also that a transmitted signal be put on the air. This is all right when such measuring equipment is available. It is not necessary, however, to have either measuring apparatus or a signal from a transmitter in order to determine with fair accuracy the field pattern of a directive array or the effectiveness of a quarter- or half-wave antenna.

Did you know that merely scraping one end of a piece of bare wire approximately one half wavelength long with another short piece of bare wire — or, for that matter, any other piece of metal — will make the half-wave wire radiate a minute signal? Well, it does, and a wire used in this manner has several very useful applications, particularly in tuning 112-Mc. antennas. As a matter of fact, it may be used to check any antenna system where the dimensions of the half-wave wire are not so large as to make its use unwieldy.

The first thing to do is to set up the antenna to be investigated in any location which will permit a person to walk around it. The antenna should be on the same level as the test wire when the latter is held by the person operating it. If the receiving antenna is vertical the test wire should be held vertically, since polarization is quite noticeable. Naturally, the preferred location is the spot where the antenna eventually is to be used.

Now couple the receiver (it makes no difference whether it be a superhet or superregenerative job) to the antenna, setting the coupling at its approximate optimum position. Turn the receiver on and set its volume control for full output, since the transmitting range of the test wire fortunately is very limited. It is this limited range that requires the preliminary test to be made while holding the test wire in close proximity to the receiving antenna.

A few words about the proper place to hold the test wire. Since this wire acts exactly like any antenna, it must be held in the operator's hand at a point where a current loop normally would exist. If one holds the lower end of a half-wave wire in one hand and scrapes the upper end with a metal rod held in the other hand, for instance, no signals will be generated, since the end held in the hand is effectively grounded. A quarter-wave or three-quarter-wave wire may be held at the end. However, since a person's body absorbs considerable energy from the test wire, just as it would from a transmitting antenna, do not stand between the wire and the receiving antenna.

Hold the test wire away from your body and close to the receiving antenna, and start scraping. The "signal" will sound just like what it is — the scraping together of two pieces of metal. Note the volume of noise from the receiver. Back away in a straight line until the noise disappears, and note this distance from the antenna. Repeat this process along lines radiating in different directions from the receiving antenna as a center.

It will be observed that the "fade-out" points vary in distance from the antenna in proportion to the gain of the antenna in any given direction. If these points are plotted on polar graph paper, a line connecting the points will provide a picture of the antenna's field pattern.

There are many applications for this type of checking. For instance, it is possible to judge the approximate front-to-back ratio of any directive array. Simply compare the maximum forward distance to the maximum backward distance at which "fade-outs" occur, and that's the ratio.

Whether or not a certain directive array has a worth-while gain over any half-wave or three-quarter-wave antenna also may be determined. Obtain the maximum "fade-out" distance from first one and then the other antenna, by the method described above. Comparison of these two distances gives the comparable effectiveness of the two antennas. In one instance it was found that a half-wave antenna could not pick up the test signal beyond a distance of five feet, while a three-element array connected to the same receiver made it possible to pick up the test signal at a distance of nearly twenty-five feet. Of course, actual distances in such cases will vary with the sensitivity of the receiver used.

The comparative sensitivity of two or more receivers can be measured, provided each receiver in turn is connected to the same antenna and the coupling is adjusted to the optimum position for each. This seems to suggest an interesting capability test for those who might like to know whether or not their receiver's performance actually is superior to the other fellow's. The receiver which can pick up the test signal from the greatest distance has the best sensitivity, of course. — *W. E. Bradley, W1FWH.*

—•••—

SENSITIVE BATTERY-OPERATED TEST RIG FOR V.H.F. WORK

A sensitive field-strength and frequency meter employing miniature 1.4-volt tubes is shown schematically in Fig. 718. This compact unit has proved its usefulness in adjusting antennas and transmitters for maximum output, and for checking frequencies. It is also useful as an overmodulation indicator.

The circuit uses a 1T4 grid-leak detector and a direct-coupled 3S4 amplifier. When a signal is tuned in, bias on the grid of the 1T4 effects a decrease in the plate current of that tube. This decreases the bias on the grid of the 3S4, resulting in a rise in its plate current. The 3S4 is not biased to cut-off since to do so would bring the tube operation into an unfavorable portion of its cruve, resulting in lowered amplification.

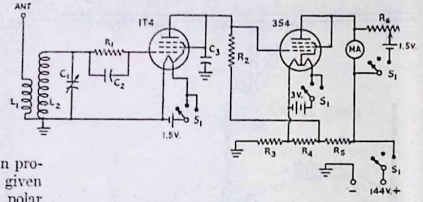


Fig. 718 — Circuit diagram of a sensitive v.h.f. field-strength and frequency meter.

C_1 — 2-plate midget variable.
C_2, C_3 — 0.0001-μfd. mica.
R_1 — 1 megohm, ½-watt.
R_2 — 0.5 megohm, ½-watt.
R_3 — 4000 ohms, ½-watt.
R_4 — 15,000 ohms, ½-watt.
R_5 — 10,000 ohms, ½-watt.
R_6 — 1200-ohm potentiometer, wire-wound.
L_1 — 2 turns No. 14, wound at grid end of L_2.
L_2 — 3 turns No. 14, ½-inch diameter, spaced diameter of wire.
S_1 — 4-gang 3-position rotary switch.
MA — 0–1 ma. or less.

The purpose of the battery and rheostat, R_6, in the meter circuit is to balance out the static plate current of the 3S4. The connections of the filament switch, S_1, are arranged to permit the tubes to draw current the instant that "B" voltage is applied. Otherwise, before the filaments were heated a reverse current of 4 or 5 ma. would flow through the meter, with possible disastrous results.

Everything except the "B" battery is assembled in a sheet-metal box measuring about 7 × 4 × 3 inches. The tubes and tuned circuit are mounted on a shelf placed just far enough down from the top so that tubes can be inserted and so that the tuned circuit will clear the box cover. Other components, including the 1.5-volt dry cells, are mounted below the shelf.

Flashlight cells are used for the filaments and meter circuit, while one of the Signal Corps BA-32s, made available for WERS installations, supplies the high voltage. A voltage divider, R_3, R_4, R_5, is placed across the 144-volt section of the BA-32 to supply the various voltages required in the direct-coupled amplifier.

When the unit is used for checking modulation it will be observed that the meter kicks up to about twice its normal reading, on peaks, with 100 per cent modulation.

Satisfactory indications can be obtained at distances of 20 to 30 feet from the usual types of mobile WERS rigs, and up to 100 feet from the more powerful fixed stations. — *Robert S. Smith, LSPH, 3019 Ruckle St., Indianapolis 5, Ind.*

8. *Hints and Kinks . . .*

for Keying and Monitoring

KEYING E.C. OSCILLATORS

Having built the e.c.o. described by Browning and Tilton in *QST* for July, 1938, I encountered trouble in keying the oscillator for break-in work. Since many others have undoubtedly built the same unit, the simple change I made should be of interest. The original circuit is shown in Fig. 801-A, while the revised circuit is shown at (B). With the original circuit, the short-circuiting of the blocking condenser apparently changed the tuning sufficiently to cause a very decided chirp. Even the difference in lengths of the paths between the base and the dot and dash contacts of my bug was sufficient to cause a noticeable difference in frequency. With the revised circuit all of these difficulties were eliminated, and the unit keys very well.

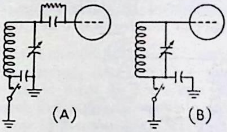


Fig. 801 — **Removing the blocking condenser from the tuned circuit eliminated keying chirps for W9UUH in using the Browning e.c.o. B shows the revised circuit.**

The change requires insulating the tuning condenser from ground. — *Lafe H. Rees, W9UUH.*

—···—

In the circuit shown in Fig. 802, an old anti-blinking scheme is used by W. Wallace, W9EYH, to keep the plate voltage constant while keying his e.c.o. A variable cathode resistor in the 6L6 buffer stage is adjusted so that the total current read by the meter is the same with key open or closed. The load remaining constant, the voltage also remains constant under both conditions. Since the total current is between 45 and 50 ma. the 6L6 buffer need dissipate only about 12 watts, which is well within rating.

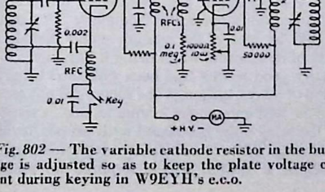


Fig. 802 — **The variable cathode resistor in the buffer stage is adjusted so as to keep the plate voltage constant during keying in W9EYH's e.c.o.**

—···—

ANCHORING THE BUG

For once, the brasspounder gets a lift from the bee-keeper. Those who are fed up with chasing a bug all over a slippery table top, but who do not wish to disfigure the table, may simply go to a bee-keepers' supply house and purchase a sheet of what is known as "brood foundation." This is a thin, waffle-like sheet of beeswax, used by the bees to build their comb upon. If the wandering bug is placed upon a sheet of this material, just laid upon the table, I defy a blow from a twelve-pound sledge to move it in any direction.

Why did I have to suffer for years before discovering this? — *H. Seymour Jones, W6AX.*

—···—

CHEAP RELAYS FOR KEYING AND OTHER USES

Perhaps many of the radio amateurs have overlooked an excellent supply of relays for keying, control and numerous other uses around the ham rig.

With simple adjustments and alterations, inexpensive auto generator cut-outs make reliable, fast-acting relays which can follow a "bug" at 40 w.p.m. These cut-outs can be picked up when discarded at garages. About half of these so-called worthless cut-outs are still serviceable as relays. If worst comes to worst, brand-new ones can be purchased at mail-order houses for as little as 27 cents each, prewar price.

The alterations are simple. Carefully remove the dust cover. Cut and remove the larger outer winding from the core, being careful not to damage the high-resistance winding of fine wire. Next, loosen the spring tension on the armature. This is necessary because the tension is factory-adjusted to require a generator voltage of about 7 to close the contacts. By loosening this tension, the relay will work satisfactorily on as low as 1½ volts, although 3 volts is better. The spring tension is adjusted by bending the spring holder or stretching the spring, according to the individual relay construction.

When the tension is okay, clean the contacts (if an old cut-out is used), adjust the spacing of the contacts, put a connecting lead on the lower contact strip, and replace the dust cover.

These units make excellent relays where single-contact single-throw is needed. They are fully shielded and quite noiseless in operation. I have found the Ford cut-out makes the best relay and is easiest to convert, although Delco-Remy and others are satisfactory.

Originally the upper contact is shorted to the frame of the relay, along with one lead from the high-resistance winding. If desired, a little ingenuity will show how to insulate these two connections. — *Harold K. Long, W7CQK.*

* * *

OSCILLATOR KEYING CIRCUIT FOR CLICK ELIMINATION

Fig. 803 shows an oscillator keying circuit which I have found effective in eliminating key clicks. Even with a 2A5 at 250 volts, clicks with ordinary cathode keying were ruining reception on all b.c. receivers here — and there are ten of them in the building. In this circuit an impedance, *L*, is inserted between the cathode and ground to prevent oscillation and yet maintain a d.c. connection between cathode and ground. This causes the oscillator tube to draw screen and plate current continuously and, if the load is adjusted to the correct value, a set of conditions may be found wherein these currents are essentially the same with the key open or closed.

Any inductance which, with the stray capacities connected across it, will tune the cathode circuit to a frequency lower than that of the crystal should prevent oscillation. I use an r.f. coil taken from an old b.c. receiver. The chief disadvantage of the circuit is that the key leads form part of the r.f. return circuit, although it works successfully with keying leads up to at least 6 feet long.

One nice thing about the circuit is that there is no d.c. across the key, so that you can put your fingers across the key without getting hurt. It is a simple job to change over any standard cathode-keying system merely by substituting the coil for the usual by-pass condenser. While I have not tried the circuit with the 6L6, it should work equally well with a coil of appropriate size. However, plate voltage should be limited so that the rated dissipation of the tube is not exceeded when the circuit is not oscillating. — *Lucius Smith, W5FXO.*

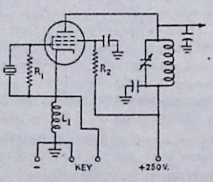


Fig. 803 — Keying circuit used by W5FXO to eliminate clicks. L_1 may be almost any coil resonating in the circuit at a frequency lower than that of the crystal. R_1 and R_2 are the usual grid leak and screen-dropping resistors, respectively, 50,000 and 20,000 ohms for a 2A5. Other tubes will require other values.

Note. — This circuit is quite similar to the one in which a cathode resistor is used instead of the inductance. The resistance method has the advantage that the key leads may be by-passed, but it is not always possible to find a value of resistance which will stop oscillation and yet not cause considerable difference in plate current when the key is open. — Editor.

* * *

KEY-CLICK FILTER

Fig. 804 is a variation of the usual resistance-capacity key-thump filter as applied to center-tap keying. In ordinary practice the grid leak or bias supply return is to ground; in this case it is made to the junction of a resistor and condenser connected in series across the key. The probable effect of the change is to slow down the cutting off and building up of grid bias, thus helping to round off the sharp break which results in clicks.

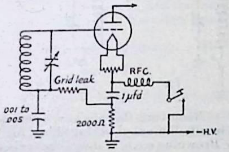


Fig. 804 — Key-click filter for center-tap keying.

This suggestion, which comes from W8EWM, no doubt also may be applied to circuits having parallel grid feed as well as the series arrangement shown in Fig. 804.

* * *

SYSTEMS FOR BREAK-IN AND KEYING MONITORING

For several years I have been watching for a simple solution to the break-in problem for c.w. operation. I was after some system which would be foolproof and one which would eliminate the nerve-racking clicks and thumps that invariably occur when the receiver is tuned near the transmitter's operating frequency. I thought it would be nice if the system could include a means of monitoring when using a bug key.

Fairly good results had been obtained using a system of relays, although the relays did not seem to follow well enough for keying at higher speeds and the relay noise interfered with proper keying monitoring. After considerable experimenting I developed a system which requires no relays.

eliminates noise from the transmitter and provides for excellent monitoring of keying.

With a little experimenting, any amateur should be able to adapt the principles to his own equipment. Very few parts need be added to incorporate the system, as shown in Fig. 805-A.

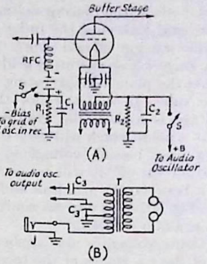


Fig. 805 — **W8NCJ's break-in arrangement for obtaining plate voltage for the keying-monitor oscillator and blocking voltage for receiver from resistances in buffer stage. C_1 and C_2 are each 0.01 μfd. S_1 is an ordinary toggle switch which is necessary only in case it is desired to have means of cutting off either voltage. See text for suggested values for R_1 and R_2. (B) shows the method of coupling the output of the audio oscillator to the headphones. J is the headphone jack in the receiver, C_3 is 0.1 μfd. and T is a push-pull audio transformer.**

Since most successful break-in systems require oscillator keying, the following amplifier and doubler stages must be biased to plate-current cut-off with excitation removed to prevent plate-current flow in these stages when the key is open. Clicks in the receiver are prevented by making the high-frequency oscillator in the receiver inoperative during the periods when the key is closed. This is accomplished by a blocking voltage which is automatically applied to the control grid of the high-frequency oscillator whenever the key is closed. This negative voltage is obtained from the drop across a resistance, R_1, placed in the grid return lead of one of the buffer or doubler stages. The value of this resistance may be determined from Ohm's Law by dividing the blocking voltage required (usually about 10 volts) by the grid current in decimal parts of an ampere. In my case, the grid current is 15 ma., so a 1000-ohm 1-watt resistor for R_1 gives a blocking voltage of 15. Receiver and transmitter chassis must be tied together and a 2.5-mh. r.f. choke connected in series with the wire to the control grid right at the tube. Since a 6J7 tube is used in the h.f. oscillator of my receiver, connection was made simply to the grid cap without disturbing any of the receiver wiring. If a single-ended tube is used in the h.f. oscillator circuit, it will be necessary to run the wire for the blocking voltage underneath the chassis to the receiver oscillator socket.

Tests were made with the blocking voltage applied to the grids of other tubes in the receiver, but blocking of the h.f. oscillator seems to remove the racket from the transmitter most completely. If it is desired to prevent possible damage to r.f. tubes, the blocking voltage may be applied in a similar manner to the grids of these stages as well, but I have not considered this necessary nor worth the added complications.

A monitoring signal for checking keying may be obtained from either an audio oscillator coupled to the headphones or an i.f. oscillator coupled to the i.f. amplifier. Plate voltage for either type of monitor may be obtained from a second resistor, R_2, connected in the plate return circuit. The value for this resistor may again be determined from Ohm's Law by dividing the plate voltage desired (usually 30 to 50 volts) by the combined plate and grid currents. My buffer draws 30 to 40 ma., so a 1000-ohm, 5-watt resistor gives 30 to 40 volts for the audio or i.f. oscillator.

The resistances should not be of higher value than required to obtain the necessary voltages for proper operation. This will be particularly important in case a very high-μ tube, such as the zero-bias type, is used in the transmitter stage, since the combination of resistances and fixed bias for plate-current cut-off may cause over-biasing of the transmitting tube. With low-μ types, the added bias from the resistance drops will not be of consequence.

Blocking of the h.f. oscillator in the receiver prevents blocking of the i.f. amplifier by the strong signal from the transmitter, so that a monitoring oscillator operating at the i.f. of the receiver will work satisfactorily. In case an audio oscillator is preferred, I would suggest that it be coupled to the headphones through a transformer as shown in Fig. 805-B. Simple capacity coupling will sometimes result in a.c. modulation of the received signals.

Since both voltage for blocking the h.f. oscillator in the receiver and plate voltage for the monitoring oscillator are developed automatically whenever excitation is applied to the buffer amplifier, no relays are required. — *R. R. Rosenberg, W8NCJ.*

—···—

While this particular system of keying a transmitter is not new, it is not in general use among amateurs. This arrangement eliminates the necessity for bias batteries or packs and will work nicely regardless of whether the transmitter operates from a single supply or from individual supplies for each stage.

The keying system used is of the blocked-grid type in which all stages of the transmitter are keyed simultaneously and for which the blocking voltage is obtained from the drop across a common cathode resistance. This resistance is of sufficiently high value to limit the plate current of the stage requiring the highest cut-off bias to a low value. Other stages will be completely cut off. The key merely short-circuits this resistance. The only disadvantage of the system is that the amplifiers will draw high plate current should the oscillator fail to function but only so long as the key is closed so that there is little danger of damage to the tubes.

The circuit includes an ordinary audio oscillator employing a receiving triode which feeds into the audio amplifier of the receiver so that the keying may be monitored. This oscillator is keyed simultaneously with the transmitter, since its grid return is tied into the common return lead. The output level may be adjusted by R_7, making it unnecessary to disturb the setting of the receiver audio gain control.

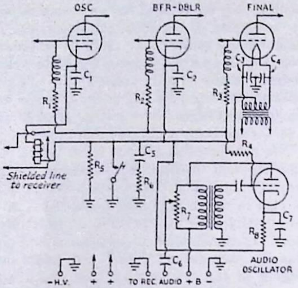


Fig. 806 — Circuit of the break-in system described by W5DGP. See text for suggested values.

The circuit, shown in Fig. 806, also includes a relay connected in the cathode circuit of the oscillator. A relay which will operate at the plate current of the oscillator may be used to disable or partially disable the receiver should this be found desirable. The leads between the relay and the receiver should be well shielded.

The resistances R_1, R_2, R_3 and R_4 are grid leaks of usual values appropriate for the tubes in use. C_1, C_2, C_3 and C_4 should have a capacity of about 0.01 μfd. C_7 should be at least 1 μfd.

The common cathode resistance, R_5, should have a value high enough to reduce the plate-current of the stage requiring the highest cut-off bias to a low value. The other stages will then be cut off completely. The value will probably be somewhere between 25,000 and 40,000 ohms, C_5 and R_6 form the key-click filter which may or may not be found necessary.

To further increase the smoothness of break-in operation and to reduce b.c. interference, it is advisable to use a line filter and a Faraday screen on the transmitter. With the break-in relay mentioned above and the Faraday screen, the 90-watt transmitter cannot be heard 10 or 15 kc. away from its frequency. — *Don B. Crouse, W5DGP and Harold Griffith, W5GEY.*

—•••—

KEYING-MONITOR SYSTEM WITH AUTOMATIC RECEIVER BLOCKING

Having rejected most forms of monitoring arrangements requiring extra relays, power supplies, etc., I finally arrived at the one shown in Fig. 807 which seems to fill the bill perfectly here at W2GXW. As shown in the diagram, a simple triode audio oscillator feeds the monitoring signal into the headphones of the receiver through a 0.01-μfd. coupling condenser, C_2. *J* is the regular receiver headphone jack with the connection made to the ungrounded side.

Plate voltage for the audio oscillator is taken from the d.c. voltage drop across the grid leak (R_1) of one of the transmitter stages. Thus, the oscillator is keyed automatically with the transmitter. In my case, this stage is one in which an 809 is used where the biasing voltage developed across the grid leak is of the order of 75 to 100 volts. The scheme should work satisfactorily with any stage whose *operating* grid voltage does not exceed the plate-voltage rating of the audio oscillator tube. In cases where the operating bias voltage is higher, the grid leak could be tapped at a point which will give the right voltage. If a fixed biasing voltage is required for plate-current cut-off, it will be necessary to introduce it between the grid leak and r.f. choke as shown in Fig. 807-B to prevent continuous operation of the audio oscillator.

The biasing voltage is also applied to the grid returns of the r.f. stages of the receiver through R_2, effectively cutting these stages off whenever the key is closed. R_3 and C_3 form the usual a.v.c. filter in the receiver. The usual grounding switch which cuts out the a.v.c. is replaced with a s.p.d.t. switch so that the monitoring system may operate with the a.v.c. system off and that the monitoring system will not interfere with the a.v.c. system when it is in use. C_1 provides time delay which may be adjusted by a change in its capacity.

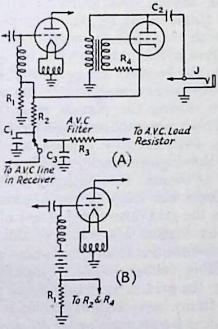


Fig. 807 — Break-in keying-monitor system with automatic receiver blocking. R_1 is the usual grid-leak resistance recommended for the stage in use. R_2 is a 0.1 megohm 1-watt resistor. A capacity of 0.25 μfd. is recommended for C_2, although this value may be varied for a change in delay. C_3 is 0.01 μfd. C_3 and R_3 form the usual a.v.c. filter in the receiver.

The circuit has no effect upon the operation of the transmitter since the current consumed by the audio oscillator is less than 0.25 ma.

The arrangement as shown in Fig. 807 has proved very satisfactory as only a few additional connections are required in the transmitter and receiver. The few extra parts for this device are also usually available. — *J. F. Masterson, W2GXW.*

ELECTRONIC MIXER FOR MONITORING

THE circuit of Fig. 808 is suggested by Francis Higgins, W8RX, as a means of eliminating switching, split headsets, and other schemes which have been devised to permit feeding the monitored signal into the 'phones during transmission. As the diagram shows, the first audio tube in the receiver is a twin triode. Its plates are in parallel but one grid is connected to the detector output and the other to the output of the monitor or keying oscillator. A gain control on the latter grid permits adjusting the monitor signal to the desired level.

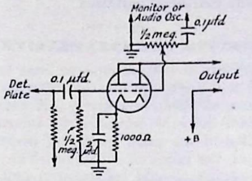


Fig. 808 — **Using a twin triode for introducing the monitor signal into the receiver output.**

This arrangement would seem to be ideal for monitoring with break-in.

* * *

COMBINATION CODE-PRACTICE OSCILLATOR AND KEYING MONITOR

FIG. 809 shows the circuit diagram of a code-practice audio oscillator which may be converted for use as a keying monitor by a flip of the switch. This is a useful combination, since the unit may be used for code practice without the transmitter running or by keying in unison with a received signal from a tape transmitter. This practice has often been suggested as an excellent means of improving the correct formation of code characters.

When the unit is used for code practice the switch is thrown to position 2, in which 115 volts from the line is fed to the plate of the rectifier, the additional filter condenser, C_4, is connected across the output of the rectifier, and the key is connected in the circuit.

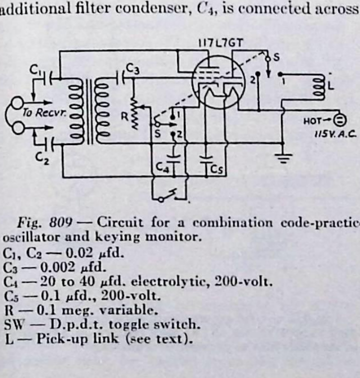


Fig. 809 — **Circuit for a combination code-practice oscillator and keying monitor.**

C_1, C_2 — 0.02 µfd.
C_3 — 0.002 µfd.
C_4 — 20 to 40 µfd. electrolytic, 200-volt.
C_5 — 0.1 µfd., 200-volt.
R — 0.1 meg. variable.
SW — D.p.d.t. toggle switch.
L — Pick-up link (see text).

When the switch is thrown in the opposite direction the line voltage is removed from the plate of the rectifier, the key is short-circuited, and the extra filter capacity is removed. Plate voltage for the oscillator is now obtained from a pick-up loop, *L*, coupled to one of the transmitter stages. Thus no keying connection is required when the oscillator is used as a keying monitor because the oscillator operates only when the transmitter is being keyed.

The output of the oscillator is coupled to the headphones through a pair of condensers, C_1 and C_2. C_2 should be connected to that side of the 'phones which is grounded. This may be determined easily by interchanging the connections to the headphones. With the wrong connection very little, if any, signal will be heard. If a 'phone plug is used which leaves the 'phone tips exposed, it is a simple matter to make the necessary connections by means of clips.

The pitch of oscillation may be adjusted by varying the value of *R*. Only one connection for the 115-volt line is shown. The return is made by a connection to an actual ground, such as a water pipe or the station ground, as indicated in the diagram. If the power plug is inserted in the socket in the wrong direction, there is no danger of blowing a fuse should the chassis be grounded. Of course, no supply voltage will be obtained unless the plug is inserted correctly. — *1st Lt. J. M. Lattig, W9QJR/5*

* * *

KEYING MONITOR

THE 117-volt filament tubes can be conveniently applied to many amateur uses, for there are no dropping resistors nor transformers for the filament circuit. The keying monitor shown in Fig. 810 is a practicable application of the 117L7GT. It consists of an ordinary "growler" or audio oscillator which utilizes one-half of the tube, while the other half rectifies a small portion of the radio-frequency output of the transmitter to provide the required "B" supply for the "growler."

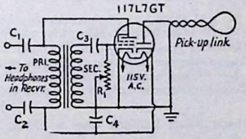


Fig. 810 — **"Powerless" keying monitor used at W2FEN. Plate voltage for the audio oscillator is obtained by picking up and rectifying a small amount of r.f. from the output stage.**

C_1 — 250-µµfd., mica.
C_2, C_3 — 0.01-µfd. paper.
C_4 — 0.1-µfd. paper.
R_1 — 0.1-megohm variable.
T — Audio transformer.

This circuit was developed to feed in parallel into the headphones which are connected at all times to the receiver. If the headphones are not to be used in conjunction with the receiver, C_1 can be increased to 0.01 μfd. This will give an increase in volume. On the particular receiver in use a ground hum could be heard distinctly until C_1 was reduced to a small value. The pick-up link consists of two turns of well-insulated wire, about 3 inches in diameter, connected to the monitor by a twisted pair. The amount of power used is very small, which allows the pick-up link to be coupled to almost any tank coil — with very loose coupling on high power. The grid leak, R_1, is a variable resistor to adjust the tone. This is the only adjustment necessary, since changing bands or varying the operated frequency has no effect.

Other types of monitors were tried but were either noisy in b.c. sets when coupled to the receiver, or needed adjustment for changes, in frequency, or were too complicated. This monitor is completely free from b.c. interference, needs no adjustment when frequency is changed, is very compact, and is easy to build. — *C. Ray Wagner, W2FEN.*

* * *

BLOCKED-GRID OSCILLATOR KEYING

The circuit of Fig. 811 shows an arrangement for blocked-grid keying which, while somewhat limited in application, requires no extra supply for blocking voltage and has a certain advantage when battery bias is used. Its chief application is in the case of a keyed oscillator where some form of fixed bias is already provided for plate-current cut-off of following stages. The amount of fixed bias required for amplifier cut-off will in most cases be sufficient to block the oscillator.

When batteries are used for amplifier bias their service life is dependent chiefly upon the rectified grid-current flow, the life being approximately the same as though the battery were being discharged at the rate of grid-current flow. In this circuit this effect is offset by adjusting the resistance of R_2 so that the discharge current through the resistor with the key closed equals the grid current. The condenser, C_2, should be adjusted to produce the desired amount of lag for click elimination. Its value will depend upon the resistance of R_2, a larger value being required with low values of resistance for a given amount of lag. The scheme may also be applied in buffer or doubler keying in cases where the fixed bias required for plate-current cut-off of a low-μ final amplifier is sufficient to block a high-μ buffer or doubler. The circuit works very well with a keyed e.c.o. In this case, the use of C_1 is important to eliminate frequency variation.

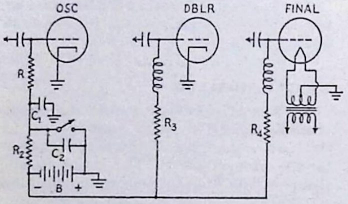


Fig. 811 — Circuit for obtaining grid blocking voltage for keyed oscillator from amplifier bias supply.
C_1 — Oscillator grid-leak by-pass, 0.01-μfd. paper.
C_2 — Lag condenser (adjust according to text).
R, R_3, R_4 — Usual grid-leak resistors.
R_2 — Keying resistance (adjust according to text).

* * *

IMPROVING THE INEXPENSIVE BUG

Some of the inexpensive bugs tend to be unresponsive at speeds less than 30 w.p.m. This is often caused by an excessively stiff main spring. This fault may be corrected by increasing the flexibility of the main spring by decreasing its width at the point of vibration. The complete arm assembly should be removed and a notch ground out of each side of the main spring close to the supporting bar. The notches should be semi-circular rather than V-shaped and enough metal removed to make the spring about one-half its normal width. The maximum dot speed is lowered, but the action is much snappier at all useful speeds. — *Chas. Rockey, W9SCH.*

* * *

NOTE ON TUBE KEYING SYSTEMS

W5CY points out that a reduction in drive to a stage in which a tube keyer is connected may result if provision is not made to keep the operating bias at the same value as is used without the keying tubes. The amplifier grid return is normally made to ground as shown at (A) in Fig. 812 so that if the keyer tubes are connected between the amplifier center tap and ground the voltage drop across the keyer tubes will be applied as additional bias to the grid. W5CY suggests connecting the grid return to filament center tap, as shown at (B), but this leaves the keying tubes in the negative high-voltage line only. It should be possible to effect an equivalent remedy by simply decreasing the grid-leak resistance, leaving the grid return connected to ground and maintaining the center-tap keying arrangement.

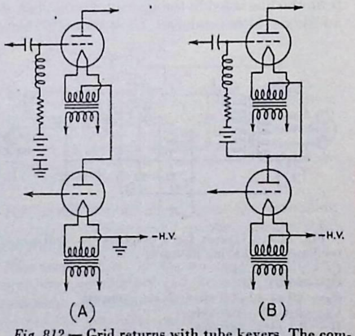


Fig. 812 — Grid returns with tube keyers. The common version shown at (A) may require an adjustment of amplifier bias to prevent over-biasing.

9. *Hints and Kinks . . .*

for Test Equipment

SIMPLIFIED METER SWITCHING

To obtain meter economy, provide rapid meter circuit and range shifting, eliminate meter jacks, and avoid necessity of drilling many large holes in front panels, amateurs are now making wide use of meter switching. The installation at W3GKP incorporates a single 0–1 d.c. milliammeter in an arrangement for voltage and current measurements at the turn of a single knob. This simple metering system should interest fellows with multistage transmitters and limited measuring equipment.

The meter, a Weston model 341 with 33 ohms internal resistance, would require shunt resistance of 0.165 ohm for 200 ma. and 0.066 ohm for 500 ma. in the arrangement ordinarily used for milliammeter range multiplication. In view of the expense of such resistors and of the errors which would be introduced by an ordinary tap switch in series with the shunts, the higher-resistance arrangement of Fig. 901 is considered simpler and less expensive. A combination of series and shunt resistor values may be chosen which will permit use of stock sizes, and thus will make the cost of additional ranges only a few cents each. The resistor values should be held to reasonable limits, however, determined by permissible voltage drop across the milliammeter system.

Since a low-current milliammeter may conveniently be used for measuring electrode voltages, it was decided to incorporate a voltmeter in the switching system. The resulting voltmeter-milliammeter combination circuit is given in Fig. 902. Although there are shown only three voltage and three current ranges, the number which may be provided is limited only by the number of switch contacts and the available resistors.

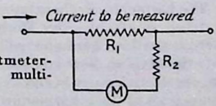


Fig. 901 — Voltmeter-type milliammeter multiplier.

With this switching arrangement all of the transmitter circuits involved are left in operating condition with the meter system connected, and the meter may be moved from one circuit to another, voltmeter or milliammeter, without interference to the transmitter operation.

The current shunt resistors, R_4, R_5, and R_6, are all 10-ohm 1-watt carbon units, except R_6 when used for 500 ma., which then should be a 5-watt wire-wound resistor. The values of voltmeter series resistors, R_1, R_2 and R_3, and the milliammeter series resistors, R_7, R_8, and R_9, may be obtained from the table below:

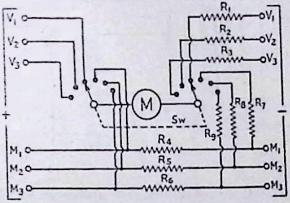


Fig. 902 — Complete three-range voltmeter and three-range milliammeter which may be used to read on any of six circuits by rotation of switch to proper position. Resistor values are given in the text.

Voltage Range	*Series Resistor*
100 volts	0.1 megohm
200 "	0.2 "
500 "	0.5 "
1000 "	1.0 "

Current Range	*Series Resistor*
25 ma.	200 ohms
50 "	450 "
100 "	1000 "
200 "	2000 "
500 "	5000 "

All of the above may be 1-watt carbon resistors except the 1-megohm resistor for the 1000-volt range, which should be two 1-watt 0.5-megohm carbon resistors in series, so that not more than 500 volts is placed between the ends of any resistor. Also, for each voltage range above 500, a 1-watt carbon resistor of 5000 ohms should be connected across the pair of switch points that are to be used.

One-watt carbon resistors can be obtained in a wide range of even values and have a reasonable constancy when not subjected to overloads. They can be supplied with tolerance of 5 per cent upon request, or the constructor may select accurate resistors by means of a calibrated ohmmeter. This provides an over-all meter accuracy well within 10-per-cent limits, an accuracy quite suitable for most amateur purposes. An exception to this is the measurement of current and voltage of an amplifier of more than 900 watts input. — *William L. Smith, W3GKP–N3GKP.*

—····—

A MULTIRANGE V-O-M

I NEEDED a double-section multipoint rotary switch in the construction of a multirange volt-ohm-milliammeter, but couldn't get it. Since I had only a single multipoint switch section, the circuit shown in Fig. 903 was used.

For voltage measurements, a range is selected on the switch, and jacks J_2 and J_3 are used for the input. Resistors R_4 and R_5 (points 4 and 5) are the series multiplier resistors.

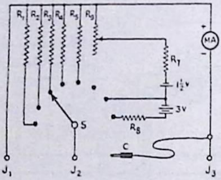


Fig. 903 — Circuit of the simplified multirange V-O-M.

R_1, R_2, R_3 — Current (shunt) multiplier resistors (values depending upon ranges desired).
R_4, R_5 — Voltage (series) multiplier resistors (values depending upon ranges desired).
R_7 — 1000 ohms, ½ watt.
R_8 — 3000 ohms, ½ watt.
R_9 — 1000-ohm potentiometer.
S_1 — Single section multipoint rotary switch.
J_1, J_2, J_3 — 'Phone tip jacks.
C — Flexible lead with 'phone tip.
M — 0-1 ma. milliammeter.

For current measurements, range 1, 2, or 3 is selected, flexible connector C is plugged into J_2, and J_1 and J_3 are used for the input.

For high-range resistance measurements, range 7 or 8 is selected and J_2 and J_3 used for the prods.

For low-range resistance measurements, C is plugged into J_2, while J_1 and J_3 are used for the prods.

The low-resistance range was designed for minimum current consumption. The number of ranges shown is merely suggestive and each builder may suit his own needs, within the limits of the switch available.

No values are given for shunts or multipliers, since these will depend upon the meter used as well as on the choice of ranges desired. [Data on their design will be found on page 420 of the 1945 *Radio Amateur's Handbook*. — EDITOR] A 1-ma. movement was the basis of my own meter.

This V-O-M is a practical, economical and efficient all-around service instrument. — *Pvt. David M. Rice, W2NXR.*

EXTENDING THE USEFULNESS OF A 100-KC. OSCILLATOR

A 100-kc. e.c.o. secondary frequency standard, such as one of those described in past issues of *QST* and in the *Radio Amateur's Handbook*, may be used for calibrating points between the usual 100-kc. intervals if advantage is taken of the fact that its frequency may be varied a few kilocycles either side of the 100-kc. point. If care is used, accurate points every few kilocycles may be obtained in the amateur bands, using b.c. station carriers as reference frequencies.

As an example, one of our local b.c. stations operates on 1320 kc. By increasing the frequency of the e.c.o. so that the thirteenth harmonic falls at 1320 kc. instead of 1300 kc., new harmonics at 3553.846, 3655.385, 3756.924, 3858.461 and 3960 kc. are obtained. Again increasing the frequency of the e.c.o. until the *ninth* harmonic zero beats with a carrier on 930 kc., still more frequencies may be spotted in the 80-meter band, viz., 3513.333, 3616.666, 3720, 3823.333 and 3926.666 kc. In certain cases, the same b.c. carrier may be used as a standard for more than one set of ham-band harmonics. For instance, a carrier at 1270 kc. will permit the calibration of both the twelfth and thirteenth harmonics of the e.c.o. with only a slight change in e.c.o. frequency. Thus two sets of ham-band points may be obtained with the single b.c. carrier as a standard. It is advisable to use only local or clear-channel stations, so that interference will not hamper adjustment to zero beat.

Considerable care must be exercised in making sure of the order of any particular harmonic being used, both in the b.c. band and in the amateur band. To minimize chances of error in the selection of the proper harmonics, it is advisable first to set the e.c.o. standard at 100 kc. by WWV, working from there as a starting point and marking the 100-kc. points on the dial of the ham-band receiver. Any changes in the 100-kc. setting of the standard should be made in very small steps, so that there may be no inadvertent shifting to harmonics above or below the desired one.

As an illustration, let us return to the case previously cited where a b.c. carrier on 930 kc. is used as the standard. The b.c. signal on 930 kc. is first tuned in on the b.c. receiver. Then the e.c.o. secondary standard is set to 100 kc., its ninth harmonic falling at 900 kc. If the frequency of the e.c.o. now is increased slowly until a beat is heard at 930 kc., it may be safely assumed that this is the ninth harmonic.

The harmonics in the amateur band should be watched simultaneously. With the e.c.o. set at 100 kc. the 35th harmonic will be found at 3500 kc., the 36th at 3600 kc., the 37th at 3700 kc., etc. As the frequency of the e.c.o. is increased the frequencies of these harmonics will also increase. When the e.c.o. is set so that a harmonic of known number is at zero beat with a carrier of known frequency, the frequency of the harmonic falling in the amateur band may be obtained by dividing the frequency of the b.c. carrier by the number of the harmonic being used in the b.c.

band and then multiplying by the number of the harmonic being used in the amateur band. For instance, in the example given above, the b.c. frequency is 930 kc. and the harmonic used in the b.c. band is the 9th, while those used in the ham band may be the 35th, 36th, 37th, etc. Therefore the frequencies in the amateur band are

$$\frac{930}{9} \times 35,\ \frac{930}{9} \times 36,\ \frac{930}{9} \times 37,\ \text{etc.}$$

Accuracy will not be materially affected by the use of broadcast-station carriers in the place of WWV for setting the e.c.o., since modern stations rarely approach the limit of the required tolerance of a deviation of 20 cycles from the assigned frequency. The inherent instability of a self-excited standard probably presents more of a limitation on accuracy than does the signal used for calibration. — *Allen Davis, W4CZN.*

CURRENT VS. COLOR OF PILOT BULBS

Although charts giving comparisons between percentage of emitted light and bulb current have been published, such charts are of little value without some means of making light intensity measurements. For example, how is one to know the percentage of full brilliancy of a bulb when the filament has just begun to glow with a dull red color?

To provide a means of using the apparent filament colors of pilot bulbs to indicate current values, various pilot bulbs were connected in series with milliammeter and batteries, and approximate data were taken for color-current comparisons. The results of the tests are shown in the graph of Fig. 904.

It will be noted in the chart that when the filament of the bulb becomes just visible, the current is approximately one-third full current rating of the lamp. For a No. 40 bulb this would be one-third of 150, or approximately 50 ma. With a No. 46 bulb the current would be one-third of 250 ma., or about 80 ma.

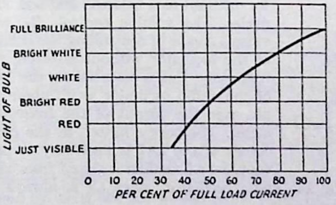


Fig. 904 — Variation in color of pilot-bulb filaments plotted against current values.

When the filament of a bulb becomes white, the current is approximately ⅔ full rating of the lamp — 100 ma. with a No. 40, or 160 ma. with a No. 46 bulb.

It is easy for the eye to distinguish between the various brilliancies from "just visible" to "white," and less easy for those between "white" and "full brilliancy," but the latter range applies only to approximately the maximum-current third of the range. The middle third of the current measuring range is accompanied by the most easily distinguished color changes in the bulb, and thus selection of the type bulb used for a definite purpose should be based on this range. When no light is visible in the bulb, the current is known to be between zero and one-third full rating of the lamp. — *Fred Sutter, W8QBW.*

METER SWITCHING

The circuit of Fig. 905 shows a meter switching arrangement used for shifting a milliammeter to any one of three circuits. A three-pole three-gang switch does the job. The meter is connected in the cathode circuit of each tube, the extra gangs being needed to complete the cathode circuits of the unmetered tubes.

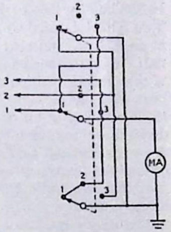


Fig. 905 — A meter-switching circuit for handling three stages. A three-pole three-gang switch is required.

In common with all circuits in which the meter is in the cathode circuit, in this arrangement the current reading is that of the total tube space current. With triodes, the sum of grid and plate currents is read; with screen-grid tubes, the screen current also registers simultaneously with the grid and plate currents. — *Ted Hansen, W9IX.*

A USE FOR METER BOXES

A measure of protection for meter and for operator results from a simple and ready use of the boxes in which meters are purchased. These boxes are usually provided with cardboard insert with large hole for the body of the meter.

In order to place the meter in immediate use, the meter and the small envelope of mounting screws are first removed from the box. A hole of ¼- to ½-inch diameter is then punched in one side near the bottom, and the meter connecting wires are carried through the side, then through the front of the box, and connected to the meter. The meter is then replaced in the box, and a sharp instrument is used to punch three small holes in the positions of the three meter-mounting holes. The three mounting screws then are pushed through the front of the meter into the holes, in which they should make a firm fit. This "boxed" meter is suitable for horizontal or vertical use on the operating table, and danger of having the connections contact metal objects or stray wiring is eliminated. — *George H. Jette, W1LEW, USN*

COMBINING THE FREQUENCY METER, 'PHONE MONITOR, AND KEYING OSCILLATOR

One of the most indispensable items of the well-dressed and well-operated ham station is the monitor, and no law-abiding amateur should think of doing without one even in these days of extensive crystal control. The best of crystals act up at times and the best of transmitters cannot always, therefore, be depended upon to perk merrily along right where it belongs; the only safe thing to do is consistently to check its operation to make sure that the signal is all in one lump, all in one place. The writer speaks from experience, remembering very vividly the expenditure of a brand-new five spot for a crystal guaranteed to hold the signal of VE2EE on a frequency of 14,398 kc.; the itch to ride the edge was upon me. Two ARRL Official Observers checked the signal at 14,403 kc. and sent me QSLs. Was my face red! At that time the station sported a monitor of the single-tube type which up to that time had been considered sufficiently reliable, but with trouble sneaking up on me so unsuspectingly I decided to build something that could be trusted. A search through *QST* brought to light articles on various frequency meter and keying monitor combinations. Culling the best features from all of these articles, and with apologies and thanks to the other boys, I worked out the useful multi-purpose gadget described here.

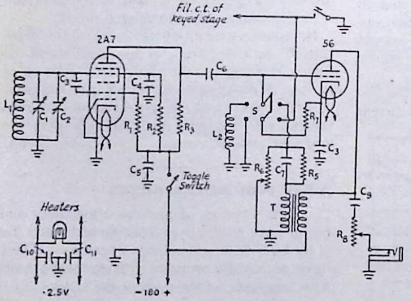


Fig. 906 — Circuit of the combination frequency meter, 'phone monitor, and audio oscillator.

C_1 — 25-μμfd. variable (bandspread).
C_2 — 50-μμfd. variable.
C_3 — 0.002-μfd. mica.
C_4, C_9 — 0.1-μfd. paper.
C_5, C_8 — 0.5-μfd. paper.
C_6 — 0.01-μfd. paper.
C_7 — 250-μμfd. mica.
C_{10}, C_{11} — 0.004-μfd. mica.
R_1 — 40,000 ohms.
R_2 — 100,000 ohms.
R_3 — 10,000 ohms.
R_4, R_5 — 0.5 megohm.
R_6 — 100,000-ohm variable.
R_7 — 15,000 ohms.
R_8 — 0.25-megohm.
L_1 — Inductance adjusted for frequency band desired.
T — Audio transformer.

The question of stability is naturally of prime importance. After talking the matter over with some of the boys the 2A7 was chosen for the oscillator, with the 56 to function as the detector. The unit was constructed and its performance exceeded all my expectations. The 2A7, after being allowed to settle, held the calibration error on the 14-Mc. band down to close to 1 kc., which is tol'able good.

It seemed to me that a 56, while doing a mighty fine job as a detector, could still be called upon to perform another duty. By rearranging the grid circuit it is made to function as an audio oscillator which provides a beautiful signal for listening to that bug. The circuit shown in Fig. 906 is easily constructed. Following through the d.p.d.t. switch it will be seen that on one side the cathode resistor is grounded, while the grid is connected to L_2. The coil L_2 consists of 5 turns of No. 20 on a tube base; without any tuning condenser it resonates at around 14 Mc. well enough to provide an S9 'phone signal with the switch in the oscillator plate in the "Off" position. *Voila*, the phone monitor!

With the oscillator plate switch closed, the carrier or keyed transmitter signal can be tuned in, by means of C_1. *Ici* . . . the frequency meter! With the d.p.d.t. switch in the other direction the grid of the 56 is connected through the grid leak and condenser, R_5C_7, and the audio transformer secondary to ground, while the cathode is connected through one wire to the center-tap of the keyed stage on the transmitter, above ground until the key or keying relay contacts are closed. The audio oscillator is thus keyed simultaneously with the transmitter. R_6 gives front-panel control of audio tone, and the pitch of the note can be varied for different ears between 300 and 5000 cycles. The volume control, R_8, provides a means of controlling the volume of the oscillator without affecting the frequency; this is essential, as the level of the audio oscillator is up about 15 db. over the output of the frequency meter. The toggle switch in the plate circuit of the 2A7 is necessary to prevent the r.f. oscillator signal from killing the audio oscillator, since C_6 is always in the circuit.

The 2A7 functions as a negative-resistance oscillator of the retarding-field type, with electron coupling to the output circuit. Its use was suggested to the writer by J. C. E. Mitchell, VE2LO. In the circuit shown, the No. 2 grid functions as a screen, the Nos. 3 and 5 grids together as a plate, and the No. 4 grid as a suppressor. The screen and suppressor are at the same r.f. potential, and when the potentials of both vary together, increasing screen potential will be accompanied by decreasing screen current and vice versa, thus giving the negative-resistance effect. The No. 1 grid is connected to the cathode. The circuit is simple to use, since no feed-back tap or coil is needed. — *Stan Comach, VE2EE.*

A SIMPLE TEST OSCILLATOR

The circuit of a simple test oscillator for lining up receivers is shown in Fig. 907. The tetrode section of the 117L7 is connected as a triode in a simple Hartley circuit, while the rectifier portion supplies plate voltage through the resistance-capacity filter, consisting of R_2 and C_2. Plate voltage may be adjusted by altering the value of R_2. With the value given, a plate voltage of about 10 will be obtained.

C_1 may be an old b.c.-receiver tuning condenser with a maximum capacity of 250 to 350 μμfd. I used two discarded i.f.-transformer windings in series for L_1, although other inductances may be used, depending upon the frequency desired. For instance, a 2.5-mh. r.f. choke with a 350-μμfd. condenser will just about cover the range of 465 kc. to 175 kc. This range includes all of the most commonly used intermediate frequencies, while harmonics will cover the higher-frequency ranges.

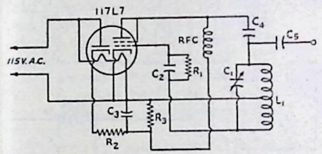


Fig. 907 — Circuit diagram of a simple intermediate-frequency test oscillator for receiver alignment.

C_1 — Old b.c. condenser, about 350 μμfd.
C_2 — 250-μμfd. mica.
C_3 — 40-μfd. 250-volt electrolytic.
C_4 — 0.001- to 0.005-μfd. mica.
R_1 — 0.1 megohm.
R_2, R_3 — 50,000 ohms, approximately.
L_1 — See text.
RFC — 10 mh. or larger, or the winding from an old i.f. transformer.

The most common type of r.f. choke is wound in four pies, so that a tap may be brought out from the center. It may be necessary in some instances to add a mica trimmer condenser in parallel with C_1 to cover the desired range.

The oscillator may be calibrated quite accurately, if desired, by beating harmonics against signals of known frequency in the b.c. band. Frequencies between 465 kc. and 275 kc. may be spotted by using the second harmonic of the test oscillator, while the remainder of the range to 175 kc. may be checked using the third harmonic. — *Bert Felsburg, W8VD.*

—···—

100-KC. CALIBRATING OSCILLATOR

The circuit of Fig. 908 is used for getting 100-kc. calibrating points. The oscillator uses a 6L6 tube with a self-resonant plate coil, and gives harmonics of good strength at frequencies as high as 30 Mc. The extremely low-C plate circuit and high-resistance grid leak contribute to the harmonic output.

Dimensions of the plate inductance, *L*, used at W9LSZ are given in the cut legend for Fig. 908. Its inductance should be such that the plate circuit will be resonant, in conjunction with the self-capacity of the coil plus the output capacity of the tube and the wiring capacity, at a frequency somewhat higher than 100 kc. — *Charles O. Becht, W9LSZ.*

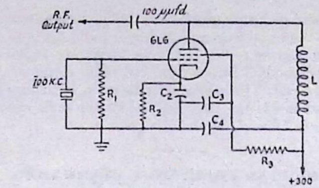


Fig. 908 — 100-kc. crystal oscillator using 6L6 for harmonic generation. The inductance, *L*, consists of three π sections, each of 500 turns of 10-strand Litz wire.

C_2 — 0.25-μfd. paper.
C_3, C_4 — 0.01-μfd. paper.
R_1 — 8 megohms.
R_2 — 500 ohms, 1 watt.
R_3 — 25,000 ohms, 2 watts.

—···—

BAND CHECKER

Here is the description of a gadget which I have found handy to have around the station. It is the absorption frequency meter in new form, consisting simply of a cardboard tube from a flashlight cell, on which a coil of No. 22 d.c.c. wire is wound, with a mica condenser of capacity anywhere between 100 and 250 μμfd. held inside by Duco cement. Pasteboard disks are cemented to the top and bottom of the tube, and a hole is drilled in the top disk for a flashlight bulb, to which wires are soldered. The bulb is held by more cement inside. All three are connected in series, as shown in Fig. 909. The turns are juggled until maximum brilliancy of the bulb is obtained when placed near a transmitter tank operating on the desired frequency. When the correct number of turns has been determined the coil is heavily doped. Final adjustment is made by squeezing the coil together or spreading turns before the dope sets. One can be made for each amateur band used, and also for troublesome harmonic ranges such as those in the vicinity of 10.5-12 Mc., 17.5-20 Mc., etc.

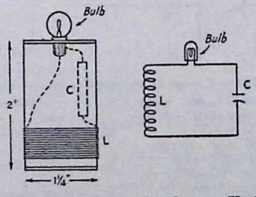


Fig. 909 — Tuned-loop band indicator. Useful for checking the band to which a stage is tuned, also as a neutralizing indicator. *C* is a midget mica condenser of any convenient capacity, *L* a coil with turns adjusted to resonate with *C* at about the middle of a band.

These pick-ups are considerably more sensitive than the usual loop and flashlight bulb. An indication can be obtained from a low-power transmitter about 7 inches from the tank, using the proper coil. The wrong coils have to be placed almost inside the tank coil before the bulb will light. — *Theo. J. Mesh, W1CCO.*

— • • • —

SIMPLIFIED FREQUENCY STANDARD

In cases where a strong local signal at the higher-frequency harmonics is not required for calibration purposes, the usual frequency standard may be simplified.

The abbreviated circuit is shown in Fig. 910. It will be noticed that the harmonic-modulated amplifier has been eliminated. The output of the 10-kc. multivibrator is used to modulate the 100-kc. oscillator directly.

The multivibrator (6N7) is locked at 10 kilocycles when $R_5 + R_6$ is about 20,000 ohms, using the constants shown in the figure. C_7 introduces the control voltage at the cathode and C_{10} connected to the suppressor of the 6SK7 results in suppressor modulation of the 100-kilocycle signal. The 10-kilocycle beat notes are slightly weaker than those at 100-kilocycle intervals and on 80 meters and higher every alternate beat note has quite a bit of hum, but this does not interfere with the ease of calibration. Output on the higher order of harmonics is naturally down, but the 14- and 28-Mc. bands can be calibrated using direct connection between the output condenser and antenna binding post of the receiver. — *W. B. Thompson, W8OKC.*

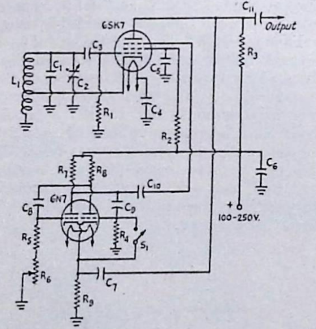


Fig. 910 — Circuit of simplified frequency standard.

C_1 — 0.0015-μμfd. mica (low-drift silver, if possible).
C_2 — 100-μμfd. variable.
C_3 — 250-μμfd. mica.
C_4, C_5, C_6 — 0.1-μfd. paper.
C_7 — 50-μμfd. mica.
C_8 — 0.003-μfd. mica.
C_9 — 0.002-μfd. mica.
C_{10}, C_{11} — 250-μμfd. mica.
L_1 — Coil from i.f.t. tapped.
R_1 — 250,000 ohms, 1-watt.
R_2, R_3 — 50,000 ohms, 1-watt.
R_4 — 40,000 ohms, ½-watt.
R_5 — 15,000 ohms, ½-watt.
R_6 — 30,000-ohm potentiometer.
R_7, R_8 — 3000 ohms, 1-watt.
R_9 — 300 ohms, 1-watt.
S_1 — S.p.s.t. toggle.

A SIMPLE BRIDGE FOR *C* AND *R* CHECKING

An audio test oscillator furnished the 100-cycle audio note for the *C* and *R* bridge shown in Fig. 911.

A double-pole, multiposition switch taken from the junk box, was used to switch from condensers to resistors in the standard position. A simple audio oscillator and power supply were built in so the unit would be complete and permanent. The oscillator can be any audio oscillator giving good headphone volume. The one used here is quite simple, with more than ample output. The only parts which may need adjustment are R_1 and C_1. They should be changed if necessary to get the desired note.

The bridge was calibrated by substitution of condensers and resistors of known accuracy in the position of the unknown "X." With two resistors or condensers of like value in the two positions of the bridge circuit, a null point (or point of lowest volume in the 'phones) will be at the center of rotation of the variable resistor. Interchanging two resistors or condensers of known value, one of which is exactly ten times the value of the other (such as 10 ohms and 100 ohms, or 0.0001 and 0.001 μfd.), points can be found on the scale of the resistor control dial where the value of the unknown part is one tenth or ten times the value of the known standard. Other divisions can be found by substituting values of other relationships, such as two-to-one or three-to-one. Additional points can be found by careful interpolation between known points.

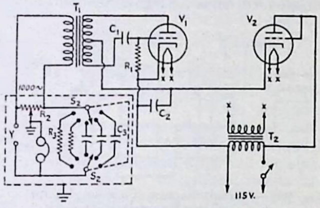


Fig. 911 — Circuit of a simple bridge for rough checking of unknown capacities and resistances.

C_1 — 0.002 μfd. mica (see text).
C_2 — 4-μfd., 300-volt filter condenser.
C_3 — Standard condensers (see text).
R_1 — 50,000 ohms to 0.1 meg., ½-watt.
R_2 — 2000-ohm potentiometer (see text).
R_3 — Standard resistors (see text).

The only precautions in construction are to shield the bridge circuit proper from the rest of the unit, and to keep all leads solid, short and well spaced. The new silver-plated mica condensers made by several reliable companies make good standards, as they can be obtained with accuracies as high as 1 per cent at reasonable cost in the lower-capacity values (up to 500 μμfd.).

While this bridge definitely does not have the accuracy of some types described in *QST*, it is simple to construct and inexpensive. It is quite adequate for the occasional use required by most hams. — *Harry K. Long, W7CQK.*

10. *Hints and Kinks . . .*

for Code Practice

IMPROVING BUZZER TONE

Two of the objections to the buzzer for code practice have been its irregular tone and unstable operation. In trying to find the cause of this, it was observed that the buzzer tone became bad whenever the contacts took a spell of sparking excessively. It became apparent that the vibration of the armature would be more regular if the sparking could be stopped. The old stunt of placing a condenser across the contacts was tried. Various values were tried experimentally and it was found that a condenser of about 8 or 10 μfd. worked best.

The buzzer contacts should be cleaned and the condenser connected. Then the buzzer should be adjusted for optimum operation, since the adjustment will be different when a condenser is used. There appears to be a resonant frequency of the condenser and the inductance of the buzzer winding to which the armature vibration can be adjusted. The contacts then do not spark, the tone is smoother and stability of operation is greatly improved. — *Horace J. Marriman, W5AYO.*

—···—

B.C. AUDIO AS CODE-PRACTICE OSCILLATOR

FIG. 1001 shows the circuit of an audio oscillator which may be easily applied to any b.c. receiver having transformer coupling to the output tube. The arrangement makes an excellent code-practice oscillator, and for the busy person wishing to build such an oscillator with a minimum of parts this may be the answer.

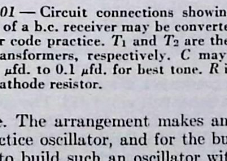


Fig. 1001 — Circuit connections showing how the audio end of a b.c. receiver may be converted to an oscillator for code practice. T_1 and T_2 are the input and output transformers, respectively. C may be varied from 0.01 μfd. to 0.1 μfd. for best tone. R is the usual value of cathode resistor.

The alterations required are very simple. The connection between the output tube cathode resistance, R, and ground is opened up and a closed-circuit jack for the key inserted. The only other addition necessary is the connection of a condenser of 0.01–0.1-μfd. capacity between the plates of the last two audio tubes. The pitch of the oscillator tone may be varied by changing the value of C. If desired, a switch may be placed between C and the plate of either tube so that the feed-back may be cut out for normal operation of the receiver. If the circuit fails to oscillate, it will be necessary to reverse connections to either primary or secondary of the input transformer, T_1. This reversal should not affect normal operation of the receiver.

In receivers employing resistance coupling, the input transformer would have to be added. — *Henry N. Fones, ex-W4GYV.*

—···—

A SURE-FIRE AUDIO OSCILLATOR

RECENTLY the urge to own a good audio oscillator came up and, having plenty of old parts around the shack, I made up my mind that I would keep working at it until it would operate correctly.

The diagram of Fig. 1002 is the result, and it certainly is a sweet outfit considering the few parts needed. The audio tone can be varied over a considerable range; it can be adjusted to feed into any reasonable impedance load; the power output is high enough for any practical purpose; and, best of all, it is not a bit critical in regard to filament or plate voltage. The 6C5 tube will operate with less than 3 volts on the heater and I

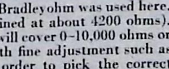


Fig. 1002 — Circuit of the sure-fire audio oscillator.

C_1 — 0.01-μfd. paper.
R_1 — Variable resistor (Old Bradleyohm was used here. Resonance was obtained at about 4200 ohms).
R_2 — Variable resistor that will cover 0–10,000 ohms or more (preferably with fine adjustment such as on Bradleyohm, in order to pick the correct note easily).
T — 6C5 tube (probably any triode can be used).
T_1 — Audio transformer.

have varied the plate voltage from 200 down to 45 volts without any trouble with oscillations stopping. The 45-volt tap was the lowest voltage tap that was available here at the time, but I believe that it would have continued working at very much lower voltages than that.

The best feature of this hook-up is the ability to change the tone pitch to any desirable note. This feature is particularly handy for i.c.w. work on the very-high frequencies since the note can be varied to just the correct pitch to cut through automobile interference.

Just a word about adjusting the outfit. You will find that both resistors will have to be varied at first to get the rig working, but a setting of R_1 will be found (in my case it was about 4200 ohms) where the resistance may be left alone and all changes in pitch will be obtained by varying R_2 in the cathode circuit. Any changes in load impedance or voltage on the tube may make it necessary to change both resistors again, but I have yet to find an impedance that will stop it from oscillating.

I hope this will help out some of the boys who have had their troubles trying to get an oscillator working. — *Gordon V. N. Wiley, W1AUN.*

—···—

A SIMPLE A.C.-D.C. CODE-PRACTICE OSCILLATOR

Fig. 1003 shows the circuit diagram of a simple code-practice oscillator which will operate from either a.c. or d.c. and which requires no transformers or other hard-to-get parts. The components can be thrown together on a baseboard within a few minutes. The oscillating circuit is a Colpitts with the headphone windings serving as the inductance. Either one or two pairs of headphones may be used across the output, or a dynamic speaker may be used by substituting the primary of the speaker transformer for the headphones. Naturally, the circuit will not work with crystal headphones.

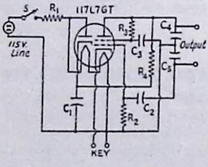


Fig. 1003 — Circuit diagram of the simple a.c.-d.c. code-practice oscillator.

C_1 — 8-μfd. 150-volt electrolytic.
C_2 — 0.01-μfd. paper.
C_3 — 0.05-μfd. paper.
C_4, C_5 — 0.02-μfd. paper.
R_1 — 50 ohms, 1-watt.
R_2 — 0.25 megohm, ½-watt.
R_3 — 1 megohm, ½-watt.
R_4 — 0.1 megohm, ½-watt.
S — S.p.s.t. toggle switch.

The output of the rectifier section of the 117L7GT is filtered by C_1. The frequency of oscillation will vary depending upon the inductance of the headphones or output transformer used. This may be compensated for by altering the value of either C_4 or C_5. One-half-watt resistors will do for all except the line resistance, R_1. The toggle switch, S, should be connected in the "hot" side of the line and the key inserted in the grounded side. — *George Masin, Long Beach, Calif.*

—···—

HINT FOR BATTERY-OPERATED CODE-PRACTICE OSCILLATORS

In using battery-operated code-practice oscillators, it is a common headache to find the filament turned on after not using the oscillator for several days. To minimize this possibility, we use an old-style filament-lighting jack for the headphone connections. Thus the filaments are automatically turned off when the 'phone plug is removed. For those who have been born since 1920, the diagram of connections is shown in Fig. 1004. — *Fran Beck, W9DB.*

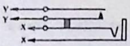


Fig. 1004 — Diagram showing connections to the filament-lighting jack. Terminals marked X go to the headphone circuit, while those marked Y are connected in series with one side of the filament.

—···—

A "TRANSFORMERLESS" CODE-PRACTICE OSCILLATOR

The diagram of Fig. 1005 shows a simple audio oscillator that requires no audio transformer and which can be built entirely from parts and tubes of any obsolete receiver. A pair of triodes of almost any type will prove satisfactory. Types 71A, 10, 45, 26, 30, 76, 56, 6J5 and 6C5 have all been used with equal results. A double triode, such as a 6N7, could be used to save space. When using directly heated tubes, the cathode connection should be made to a center-tapped resistor across the filament supply which consists of a transformer filament — winding or batteries, according to the types of tubes used.

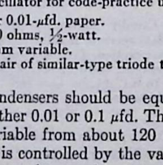


Fig. 1005 — Circuit diagram of the simple "transformerless" audio oscillator for code-practice use.

C_1, C_2 — 0.1- or 0.01-μfd. paper.
R_1, R_2 — 50,000 ohms, ½-watt.
R_3 — 0.5 megohm variable.
V_1, V_2 — Any pair of similar-type triode tubes.

The two condensers should be equal in value and may be either 0.01 or 0.1 μfd. The generated frequency, variable from about 120 c.p.s. up to the inaudible, is controlled by the variable resistor, R_3, which may be any rheostat or potentiometer having a resistance of 500,000 ohms or more.

With any type of tubes (or a combination, when rated filament voltages are equal), a supply voltage of 90 volts d.c. will be sufficient to drive a small p.m. speaker for group code practice. An increase in plate-supply voltage will raise the output level accordingly.

This circuit is a variation of the multivibrator oscillator circuit, and the note contains a certain amount of harmonics and is not altogether independent of the supply voltage. Inserting a variable high resistance in series with the output will make it possible to lower the frequency to as low as 20 c.p.s. Larger values of capacity at C_1 and C_2 will also serve to lower the frequency. — *Herbert F. Spirer, Springfield, N. J.*

—•••—

CURING CROSS-TALK IN CODE-PRACTICE TABLES

THOSE who have constructed code-practice tables for group instruction and have had trouble from cross-talk between circuits when using the usual type of high-resistance headphones will be interested in the results of an investigation of the problem made by J. R. Ortiz, W2KEV, in connection with three tables patterned after the model described in the Defense Edition of *The Radio Amateur's Handbook* and also in *QST* for May, 1941. The original circuit is shown in Fig. 1006.

Three code-practice tables, each containing ten positions, were wired strictly in accordance with the diagram. Each table developed cross-talk trouble; that is, the table could not be divided into several independent communications circuits without interference between circuits. Capacity between key contacts was first suspected and several tests were made to determine if this was responsible for the trouble. All keys were disconnected and removed entirely. The cross-talk still prevailed, indicating that the key capacity was not responsible. Next the keys were replaced and all switches removed. Since the switches are open when it is desired to send to oneself, removing them entirely did not upset the wiring. The tone background immediately disappeared. The trouble reappeared when the s.p.s.t. toggle switches were restored, however. The toggle switches were then replaced with knife-type switches in which the contacts were quite distant from each other. The tone background reappeared but it was very weak, indicating that it was the capacity between contacts of the toggle switches that was responsible.

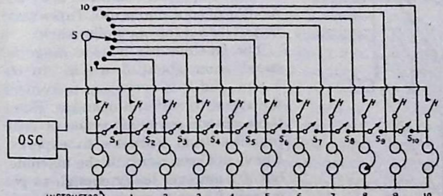


Fig. 1006 — Circuit diagram of the code-practice table wiring arrangement discussed by W2KEV. Switches marked S_1 through S_{10} are the toggle switches discussed in the text.

While working with the tables, W2KEV went a little farther. Two tables were wired with the knife switches. These are giving satisfactory service. In the third table, the toggle switches were again installed and the tone reappeared as expected. One by one the ten operating positions were cut out until, even with the toggle switches, the tone disappeared entirely. This occurred when five of the ten positions were out. With six positions, the tone reappeared; with seven, the strength increased; and with eight, it was as strong as before. Thus it would appear that five positions is the limit when toggle switches are used.

If the signal is sufficiently strong to allow some reduction, cross-talk may be reduced by shunting the 'phones with as low resistance as practicable.

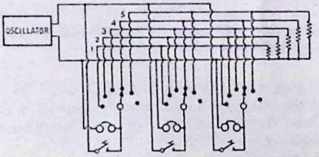


Fig. 1007 — This arrangement provides greater flexibility than the one shown in Fig. 1006. The two outside wires transmit the steady signal from the oscillator to each station, while the numbered wires each provide an independent communicating circuit. Stations wishing to communicate switch to the same line. The seven lines shown will take care of five independent communication circuits and any line may be monitored from any position. The loading resistors are discussed in the text.

While on the subject of code-table circuits, a slightly different arrangement is shown in Fig. 1007. With this circuit any combination of stations may work together on the same circuit or on different circuits. Each additional line provided will furnish an additional independent circuit. This arrangement is an improvement over that shown in Fig. 1006 in that stations which are not adjacent may work together independently of stations in between. For instance, with the circuit of Fig. 1006, should station No. 10 wish to work station No. 8, it would be necessary for station No. 9 to be included in the circuit also. With the system of Fig. 1007, any stations wishing to communicate merely switch to the same line. Those working on other lines are not disturbed. Monitoring of any circuit can be done from any position, and a student may send to himself without disturbing others by switching to the "off" position. The tap switches should be of low capacity, or a system of clips and screw contacts may be substituted. Each line should be loaded with resistance if cross-talk occurs. For a system including ten positions, a resistance value of a few hundred ohms should be sufficient.

SIMPLE WIRING HARNESS FOR CLASSROOM CODE INSTRUCTION

Code instruction at the Pittsfield (Mass.) Vocational School must be carried on in a classroom which at other times is used for chemistry classes. The students' desks cannot be wired permanently, and no special code-practice table is available.

To solve this problem, a flexible wiring harness equipped with double Fahnestock clip connectors, together with a control panel for use on the instructor's desk, was constructed in such a way that it could be very easily installed and removed.

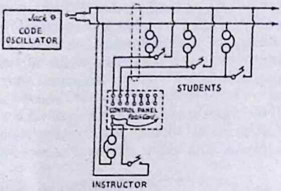


Fig. 1008 — **Diagram of a flexible wiring harness and control panel for code-practice class use.**

At the close of a class period the students simply remove their 'phones and keys. The harness is then rolled up around the control panel and the entire set-up is stored away until it is necessary to get it out for the next session.

Although fundamental ideas were drawn from the flexible code-table circuit described by W9LBJ in April, 1944, *QST*, a simplified circuit, shown in Fig. 1008, was designed to save wire and connectors. The smaller amount of wiring in the cable should reduce any possible tendency toward cross-talk and background tone. — *Milton A. George, W1BKG.*

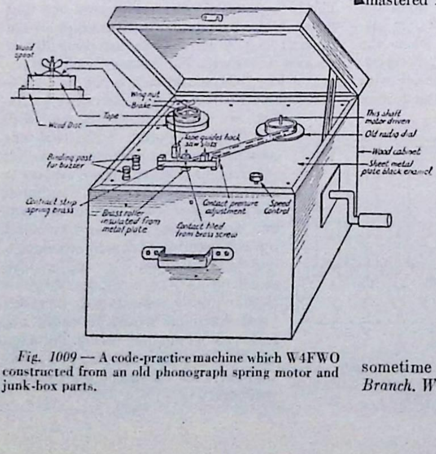

Wood spool
Wing nut
Brake
Tape
Wood Disc
Tape guides hack saw slots
Binding post for buzzer
Contact strip spring brass
Brass roller insulated from metal plate
Contact filed from brass screw
Contact pressure adjustment
Speed Control
This shaft motor driven
Old radio dial
Wood cabinet
Sheet metal plate black enamel

Fig. 1009 — **A code-practice machine which W4FWO constructed from an old phonograph spring motor and junk-box parts.**

A CODE-PRACTICE MACHINE

I have a code machine with which I mastered the continental Morse code, which can be built for little or nothing if one has or can get an old phonograph spring motor. I believe it will be of considerable interest to the would-be hams who read *QST* and the old-timer who desires to increase his code speed.

I thoroughly cleaned the motor, part by part in gasoline to remove any grit that would prevent smooth operation. The motor was carefully assembled and lubricated with a good grade of machine oil. In running a test on the motor I found that the speed of turntable shaft was too great and the power not sufficient to pull the tape, so the turntable shaft was sawed off at the frame and the gear shaft next to it was extended so as to obtain power there. In running a test on the motor again the speed was found to be correct and the power sufficient to pull the tape.

Constructional details are shown in Fig. 1009. I tape-mounted the motor with rubber shock absorbers on a sheet-steel foundation from the junk box and allowed the shaft mentioned above to protrude through. An old radio dial was mounted on it as a receiver for the tape. A post was mounted for the roll of tape. Guides were adjusted to assure accurate travel of the tape. A brass roller was used for the contact to make electrical connection through the tape. The tape travels on this brass roller similar to a belt on a pulley. The contact was filed from a brass screw in such a manner as not to damage the tape and mounted on a piece of spring brass in such a manner that it would make contact with the brass roller, thus making the dots and dashes as the tape traveled past. There are several adjustments on this contact strip to set the contact for proper pressure, etc.

The last thing to make was the cabinet which was made of wood, then stained and varnished. A buzzer and oscillator were tried on the machine, and both work FB. After about two months of steady practice of about two hours per day, I mastered 18 w.p.m. and passed the code test the first time I tried.

The machine made such a hit with other would-be hams that it has been in constant use since I finished with it, and is engaged for months to come. Only four tapes were purchased and they are in perfect condition after six months of continuous use. Tapes may be purchased for one dollar each.

The machine has a wide range in speed from about 3 w.p.m. to 60 w.p.m. and it is very easy to control the speed to suit the operator. Since these speeds cover all types of code practice, from learner's to expert's, I have not seen much of the machine, but if I am ever lucky enough to get it back, I hope to try it out on the air as an automatic sender and use it sometime for calling CQ, etc. Hi! — *J. S. Branch, W4FWO.*

11. *Hints and Kinks . . .* for the Shack

DESIGN FOR A RADIO TABLE

The bench or table shown in the diagram of Fig. 1101 may be built by anyone possessing a fair degree of mechanical skill and with a minimum number of carpenter's tools. There are no complicated joints to make, and for the most part it is simply a matter of cutting the material and nailing it together. A bench similar to the one described has been in use at W6HGW for more than two years, and it has proved to be very satisfactory.

The most important, and at the same time the most difficult, part of a table to construct is the top. It must be smooth to permit writing with ease. At the same time it must be perfectly rigid. For one who is not equipped or inclined to go to the labor of joining and gluing several boards together to form a top there are two solutions. One is to buy a panel of ¾-inch five-ply Douglas fir veneer, which may be obtained in widths of four feet and any desired length. This sheet has a perfectly smooth surface and makes an ideal table top.

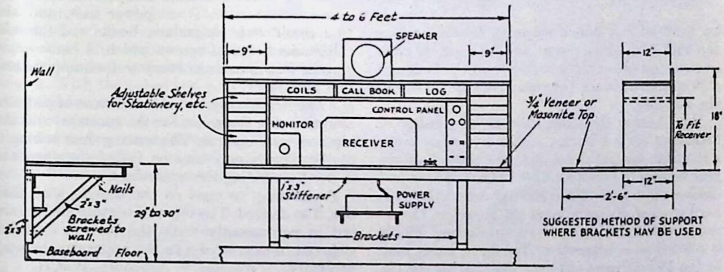


Fig. 1101 — A home-constructed operating table incorporating maximum convenience and efficiency.

The other alternative is to fasten together several fairly smooth boards with cleats, and then cover the top with a sheet of one-eighth inch Masonite or Presdwood, which is sold under various trade names in different localities. The "tempered" variety is preferable, as it has a hard, almost varnish-like surface. It is fastened to the board top with small brass escutcheon pins, by drilling small holes in the Masonite along the edges about 6 inches apart and driving the heads of the pins down flush with the surface of the Masonite. A neat-looking edge may be secured by planing the edges of the boards and the Masonite after the latter is fastened in place. A more finished job is made by using some of the brass binding which is used for covering the seams of linoleum and tacking it down along the edges of the table.

The top must be supported, which can be done in two ways. If the landlord or the XYL will permit, the better plan is to build two brackets of 2 × 3-inch material, as shown in the sketch, and fasten them to the wall by means of large wood screws driven through the plaster and into the studding of the wall. In this way there are no table legs to get in the way of one's feet. The studding in the walls may be located by tapping along the wall with a hammer until it feels solid. The studding is generally on 16-inch centers. Hence, having located one stud, it is an easy matter to locate the others by a little measuring plus a bit of patience.

If the bracket form of construction is used, it will be necessary to stiffen the top between the brackets. This may be done by nailing a 1 × 3-inch piece across the front end of the brackets, and a 1 × 6-inch piece across the front of the vertical legs of the brackets, notching it so as to clear the horizontal bracket members.

By buying all lumber surfaced on four sides, the labor of building this table is reduced to a great extent. The greater part of the work will consist of cutting the material and fastening it together. A good grade of pine looks well and, when sandpapered and finished with dark mahogany stain, it will make an operating table of which no one need be ashamed.

The table should be about 30 inches wide, and from 4 to 6 feet long, depending upon one's individual wishes. For best operating convenience the table top should be from 29 to 30 inches above the floor.

If the mention of fastening the table to the wall brings forth the storm clouds, it would be best to employ the more orthodox method of using four legs, as shown in Fig. 1102. These may be made of 3 × 3-inch material, fastened at the top with 1 × 4-inch pieces, and with a cross piece at each end about eight inches from the floor and a longitudinal brace between them, as shown in the sketches.

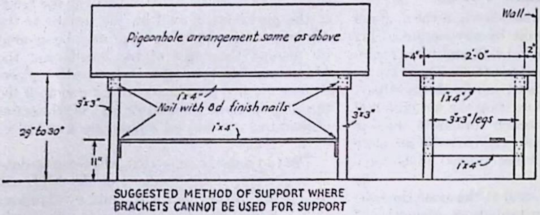

Pigeonhole arrangement same as above
1"x4"
Nail with 6d finish nails
3"x3"
1"x4"
3"x3"
29" to 30"
11"
Wall
4"
2'-0"
2"
1"x4"
3"x3" legs
1"x4"
SUGGESTED METHOD OF SUPPORT WHERE BRACKETS CANNOT BE USED FOR SUPPORT

Fig. 1102 — Another method of supporting the operating table shown in Fig. 1101.

Now, having the table, there is the question of arranging for log books, stationery, spare coils, a monitor, control panel and other miscellaneous gear besides the receiver. One's personal likes and dislikes enter into this to such an extent that it is hard to plan any definite set-up. However, the arrangement shown has proved satisfactory, and it is offered as a suggestion. The back panel may be the 18-inch piece left over after having cut the four-foot panel down to 30 inches. The rest of the shelves and pigeonholes may be made of 1 × 12-inch pine, which may be bought at the lumber yard surfaced on four sides, ready to be cut, and then nailed into place. All joints should be nailed with eight-penny finishing nails.

The receiver occupies the center of the large space, with the key and control panel on the right and the monitor on the left. The power supply rests on a small shelf under the table out of the way. The long spaces above the receiver are for spare coils, log book and call book. The speaker sits on the top shelf along with an electric clock. The small shelf on each side will hold stationery, pencils, magazines and books. These shelves may be made of wood, or better, of metal. By making saw-cuts in the side pieces about an inch apart and ⅛-inch deep, pieces of 20-gauge galvanized iron may be slid into them to make shelves which are easily adjustable to suit one's convenience. — *Thomas O. Crow, W6HGW.*

RACK-STYLE OPERATING POSITION

It is always somewhat of a problem to decide upon the operating position which offers the greatest advantages. My solution is shown in Fig. 1103. The space is put to use as follows:

A — loud speaker.
B — antenna tuner.
C — small monitor.
D — final amplifier.
E — exciter stages (two or three).
F — power supplies (receiver supply included).
G — receiver.
H — log, call book, writing paper, etc.
I — panel for switches controlling the 115-volt lines.
J — key.
K — tools, QSL cards, neon bulb, plug-in coils, etc.

The shelf at *L* is mainly a support for the bottom of the structure. It can be used for the speech amplifier and its power unit, and also to accommodate magazines, books and the miscellaneous boxes of screws which, I believe, are standard equipment in every well-equipped amateur station.

The space *H* may be made as a sort of pedestal setting inside the space for the receiver, and the receiver rests upon it. The writing desk is hinged at the bottom and may be folded up when not in use thus hiding the equipment.

Panels may be used on the shelves that slide out, if so desired. The top and bottom shelves are put in permanently while the ones in between slide out in case repairs to the apparatus become necessary. — *Winston V. Bradbury, W5CIQ.*

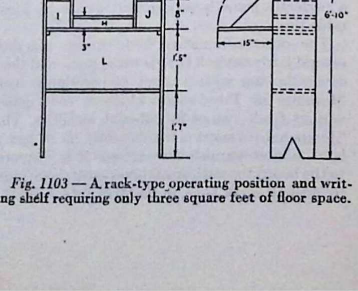


Fig. 1103 — A rack-type operating position and writing shelf requiring only three square feet of floor space.

UNUSUAL IDEAS IN TRANSMITTER CONSTRUCTION

The question of a simple and inexpensive design which will afford protection for the transmitter against dust and most accidents is at least partially answered by G. P. Anderson of G2QY. The essentials of construction are shown in Fig. 1104. The transmitter consists of a series of chassis bases for the various units mounted on a simple arrangement of shelves. The unusual feature is the depth of the bases which is sufficient to accommodate all circuit components except the tubes and the tank coils which are accessible for changing. With the tubes and coils removed, the tops of the bases present comparatively smooth surfaces which may be easily dusted. Power supply connections are made through cables with attached plugs, so that each unit can be readily removed if servicing becomes necessary.

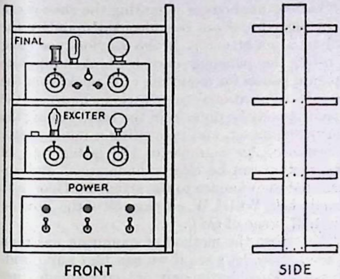


Fig. 1104 — A simple design for low- and medium-power transmitter construction which affords protection from dust and provides easy access for alterations.

—•••—

William M. Hildebrand, W8LOF, describes the novel construction of his rig, which is built into a cedar chest:

"Very few mothers or wives, who are obliged to tolerate the presence of a ham in the home, would object to an attractive cedar chest full of radio apparatus even if it is in the living room. Although it might not be their idea of good furniture arrangement to have such a chest in the living room, it would be much preferred to that of any other type of construction in which many dials, switches and other gadgets would protrude from the panel.

"The chest may be purchased at a surprisingly low cost at nearly any furniture store, or it may be built if one is particularly apt in the construction of such things. Neatness in appearance is the prime factor in the mind of the mistress of the household, and this factor should be reckoned with in the decision as to whether to buy or make the chest.

"The exterior appearance is very appealing, as shown in Fig. 1105. Only the meters, name plates, and jewel lights are to be seen. The insulators for feeder connection may be mounted on the end, while all wires leading to the chest should enter from the rear.

"For the greatest accessibility the transmitter is constructed on removable breadboards. The breadboards are supported at each end by 1 × 1-inch wooden strips, and are securely fastened to the inside of the chest with screws. The condensers are mounted on end so that the dials will face upward and the plug-in type of coil is used in the transmitter.

"All connections to the meters, key and power leads should be made with plugs and jacks to facilitate the removal of the breadboards from the chest. The breadboards need be only as wide as the apparatus requires and the remaining space may be used advantageously by building in small boxes in which to store the extra coils, soldering iron, reserve tubes, screwdriver, neon lamp, and other items which are convenient to have at hand. The power supply unit is mounted on the bottom breadboard and the r.f. unit on the top breadboard. By merely raising the lid, the necessary tuning or coil changes may be accomplished with the minimum of effort.

"It is necessary to bore small holes in the bottom of the chest and others toward the top of the back panel to furnish the necessary ventilation. The short legs of the chest raise it far enough above the floor to permit air to circulate freely through the chest, thus keeping the apparatus at a moderate temperature. [A small electric fan might help to lower the internal temperature. — EDITOR.]

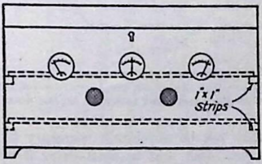


Fig. 1105 — W8LOF overcame family objections by building his entire transmitter in a cedar chest. Tuning controls are under the cover.

"A transmitter in a chest of this design would not only overcome the undesirable appearance of the usual transmitter, but would provide accessibility for coil changes or minor alterations and yet permit enclosing the entire unit against dust-accumulation and tampering by visitors or other members of the household."

—•••—

Another novel and neat arrangement of transmitter gear is that depicted in Fig. 1106. It is described as follows by Ernest L. Moline, W9SWT:

"It so happens that this problem parallels one from which I, in my own opinion at least, emerged victorious after having been plagued by it for months. Though the problem is mutual, there might be a vast difference between the architectural arrangements of respective homes which would prevent operation in the living room; but if a fellow is fortunate enough to have a clothes closet adjacent to his living room, or for that matter any unoccupied anteroom, I'm sure he will benefit from the solution which I am about to describe.

"While actual construction has not been commenced, the closet door has been measured and its cost meditated upon, as have the prices of costumers which must inevitably carry the burden of the evacuated clothes closet. After careful perusal of various mail-order catalogs, it has been found that the combined costs of a new door and a costumer is far below that of a standard commercial relay rack.

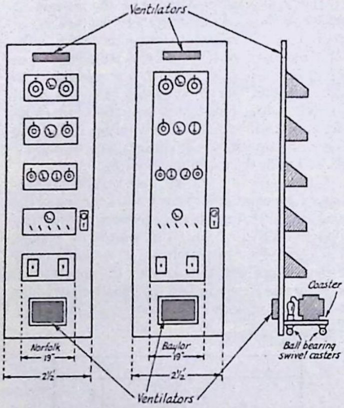


Fig. 1106 — A spare clothes closet adjacent to the operating position makes an ideal location for a transmitter, with the equipment mounted on the door.

"It may not be absolutely necessary to purchase a new door, but in most cases it will be much safer to stow the old door away somewhere in the attic for future replacement in the event that the experiment goes awry, and equip the closet or anteroom with a new door of identical style and finish. The reason for this precaution is obvious after it is learned that the door is to become the victim of drills, chisels and what-not; and will eventually emerge from the operation full of meter-holes and the like. With the anticipation of such mutilation in the mind of whoever must grant permission, that permission is more easily gained if the disfiguring is done to something besides an old heirloom or the property of a disagreeable landlord. In the end, if the work is painstakingly done, there is no reason why it shouldn't be attractive; and the chances are that the old door will be permitted to rest peacefully — and in one piece — in the attic.

"Door styles best suited to transmitter mounting are the Norfolk and the Baylor. If something more fancy is desired, the Windsor, which is basically the same as the Baylor, may be used. The Norfolk has five individual panels framed by the door proper and run horizontally, while the Baylor has only one vertical panel approximately four-fifths as long as the door and similarly framed. The width of the panels between the vertical parts of the frame on a door two and one-half feet wide is exactly nineteen inches, which makes this size door readily adaptable to the standard relay rack panels, if those are desired.

"Various methods of mounting the chassis can be employed and are best decided upon by the individual constructor. If the Baylor-type door is used, the paneling may be broken up into separate panels for mounting each deck from the front in conventional relay-rack fashion; or the mounting may be done from the rear, leaving the door panel intact, and presenting a much neater appearance. An example of the latter type of construction can be clearly understood and appreciated by reference to the article by George F. Wunderlich, W6DUW, on page 38 of the November, 1937, issue of *QST*.

"Now that the method of mounting has been decided upon, let's see if we can find any disadvantages. Possibly the only objectionable feature of mounting a transmitter on a door is the strain exerted on the hinges by the weight of the power supplies in high-power rigs, but this strain may be alleviated by mounting the power supplies permanently in the closet since there are no coils to change in a power supply. As an alternative, the power supplies could be mounted on a coaster to be moved back and forth into and out of the closet by the door.

"With the power-supply angle successfully overcome, this method of mounting the transmitter can offer nothing but advantages. Everything is flush with the wall and does not clutter up the room as a superfluous piece of furniture and, when adjustments need be made, the entire rig can be swung in an arc of 180 degrees for ease of accessibility. The high voltage is in a safe place during operation and away from inquisitive visitors; and it may also be kept away from the operator by providing interlocking switches to cut out the primary voltage to the hot stuff when the door is opened. Likewise, interlocking switches may be provided for connecting tuned feeders in the event that they are used. And when the rig is put off the air a master switch inside the closet may be opened and the door locked with the key hidden safely in the operator's pocket, insuring a thoroughly disabled rig until he returns to pound out another CQ."

* * *

SUGGESTIONS FOR DISPLAYING QSL CARDS

Little did we realize how vital the question of displaying QSL cards is to the modern amateur. His receiver tubes may burn out when he operates his transmitter, he may risk his life operating an exposed transmitter, his antenna relay may be noisy and he may catch pneumonia from draughty lead-in openings, but — by gosh! — he's extremely finicky about the way he cares for his QSL cards and how he shows them off to visiting firemen!

In writing a summary of the various ideas and combinations of ideas, we deemed it impracticable to make specific mention of the sources, in most cases, because most of the ideas were duplicated many times.

The problem resolves into three major portions, the first dealing with that of protecting the cards against dust, etc.; the second, that of devising a suitable mounting which would prevent marring walls; and third, methods of fastening the cards to the mounting with as little damage to the cards as possible.

Cellophane was chosen as a protective covering by the majority. Some wrapped each card in cellophane, fastening it at the back with glue or Dupont cement. Others used a large sheet to cover a group of several cards. Another scheme consisted of strips of heavy cellophane or celluloid the width of a card. Diagonal slits were cut in the cellophane strip to receive the corners of a card in a manner similar to that used in old-style photo albums. The use of adhesive photographic art corners also was suggested. In both latter cases, the cards were mounted on the cellophane strips with the faces of the cards against the cellophane. These strips, containing the cards, were suspended from the picture moulding. Still another scheme consisted of long horizontal pockets of cellophane made of a strip, somewhat wider than the height of a card, cemented at the ends and lower edge only. A series of these long pockets was mounted, one above the other on a suitable background. The cards may be inserted from the top. In another slightly modified form both top and bottom edges were fastened and the ends left open, so that a string of cards fastened together could be pulled through the pocket from end to end.

Several samples of wrapping were submitted and we tried some of our own. The chief objection to the use of cellophane seems to be that most of the inexpensive light-weight grades are affected seriously by changes in temperature and humidity. From the condition of most of the samples received, it seems very advisable to wrap cards very loosely to prevent buckling of the card when the cellophane shrinks. Ready-made envelopes in standard sizes are available at most stationery stores and were suggested by several. Perhaps the selection of a size which will fit the card loosely is the most satisfactory way of using cellophane for protection.

While we did not try the idea of a large sheet for covering a group of cards, it seems that wrinkling or bulging would still be a problem. A wrinkled or ripply surface makes it difficult to find any suitable position from which the cards may be viewed without experiencing the glare from reflected light.

To our minds, the most satisfactory method of protecting cards against soiling consists of brushing or spraying the cards with a protective waterproof preparation. We doubt if the process would be any more tedious than that of preparing a cellophane covering. It should be less expensive, the problem of wrinkles is avoided, and the cards are furnished with a permanently preserved finish which permits washing the cards, if necessary, without damage to the cards. Clear lacquer, clear shellac, French lacquer, clear varnish, map varnish, clear liquid celluloid, water glass and drawing fixer are suggested as being satisfactory for the job.

Most of the preparations mentioned produce a glossy surface. W1BYJ suggests a solution of 40 per cent clear metal lacquer and 60 per cent lacquer thinner. Two coats seemed to change the original surface of the card but little. W1BYJ coats the cards by dipping them vertically into a container of the solution, holding the card with a pin at one corner to prevent finger marks. The cards are suspended by means of the pin while drying, which requires about seven minutes. *He cautions against smoking or having any open flame in the vicinity of the solution which, like most lacquer preparations, is highly inflammable.*

W5ASD suggests a solution made by dissolving clear celluloid in airplane "dope" or by thinning down "liquid celluloid."

Care must be used with any of these solutions to provide a uniform surface when applied with a brush. Perhaps the best method of application is by means of a small atomizer or "blow" type sprayer, either of which may be obtained at little cost from art or stationery stores.

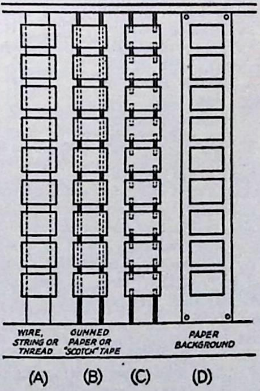


Fig. 1107 — **Four methods of suspending QSL cards.**

Several schemes for mounting the cards without marring the wall were suggested. Perhaps the most popular scheme of all consisted of a pair of strings, thread, small diameter wire, gummed paper strips or strips of so-called "Scotch" tape or masking tape. ("Scotch" tape may be obtained in rolls at any stationery store. It is coated on one side with a permanently adhesive surface somewhat similar to that of adhesive medical tape but is less expensive. It is obtainable in a variety of forms, colors and sizes. One type is transparent.)

Each pair of strips is run vertically from the top to the bottom of the wall with a separation somewhat less than the length of a card. By means of Dupont cement, stamp hinges, bits of "Scotch" tape or adhesive tape, the cards are fastened, one above the other, to the strips. (See Figs. 1107-A and 1107-B.) In the case of gummed paper strips or "Scotch" tape strips, additional fastening is unnecessary, of course. If the cards are wrapped in cellophane, they may be attached to the wires or strings by folding the cellophane over the string or wire before fastening the cellophane at the back of the card.

Another popular method is to arrange the cards in chain fashion, each card being fastened to the one above it by two small pieces of adhesive material such as those mentioned above. (See Fig. 1107-C.) With either of these methods, when necessary, the rows of cards may be taken down and folded into compact packs. A variation in this method involves punching four holes in each card and suspending one card from the one above it by means of small wire hooks. Others suggest sewing the cards in long strips with needle and thread. A rather novel method of linking the cards together is shown in Fig. 1108. This scheme was suggested by ON4CC.

Another group preferred mounting cards in groups on backgrounds of studio board, drafting paper, wall board, plywood, cardboard, quarter board and similar material with the surface covered with colored paper, cloth or oilcloth. A suitable frame or moulding was often suggested. The cards were fastened to the mounting by means of thumbtacks, Dupont cement, bits of "Scotch" tape, stamp hinges or photographic art corners. As an alternative, some suggested slitting the background material for the corners of the cards where this was practicable. W9YRF assembles several cardboard squares, on which his cards are mounted in "calendar" form, so that cards on any particular sheet may be examined by lifting the sheets above it.

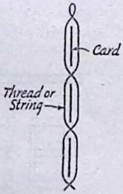


Fig. 1108 — A novel way of linking cards together.

An idea which seems to come halfway in between the two preceding methods consists of strips of colored shelf paper or wrapping paper, somewhat wider than the length of a card, extending from top to bottom of the wall, on which the cards are mounted. (See Fig. 1107-D.) W9TCK suggests a paper roller shade as a mounting and this method would be satisfactory unless some smart Joe pulled the shade and let it run up! The spring had better be removed if a shade is used.

Another novel and effective presentation of QSL cards is through the use of overlapping where only the important feature of a card is shown thus permitting many more cards to be displayed in a given area. These layouts can then be placed behind glass or cellophane in the usual manner.

A RECEIVER OR A.F. AMPLIFIER AS AN INTERCOM SYSTEM

Owners of communication receivers, or any receiver or audio amplifier for that matter, can convert the receiver or amplifier into a useful inter-room communication system by the simple addition of a d.p.d.t. anti-capacity switch as shown in Fig. 1009. The switch need not be installed in the receiver proper nor need the receiver be changed in any way. In my case, the switch is installed on a panel close to the receiver. The input and output wires are run to the switch together with the wires from the local and remote speakers. The input is nothing more than one wire with a condenser in series, plus a switch to the control grid of the 6SQ7, first audio of the SX-25, or the first audio of any receiver or amplifier. The input-to-grid connection is easily made by removing the first audio tube and wrapping one turn of fine wire around grid pin, keeping this wire as short as possible. Shielding is practicable but was not necessary in my case.

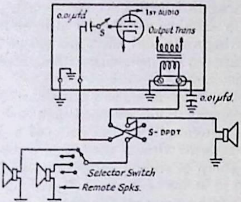


Fig. 1109 — W8PCQ uses the audio amplifier and loudspeaker of his receiver as an intercommunicating system. Only a few simple connections to the receiver are required. For transmission, using the receiver speaker as a microphone, the d.p.d.t. switch is thrown to the right, while for reception it is thrown to the left.

My receiver, an SX-25, has a 5000-ohm output with one side of the coil grounded. This ground connection makes it possible to use but one wire between the remote speakers and the amplifier, the ground being the return. However, somewhat better quality is possible if two wires are run directly to all remote speakers and the one wire grounded at the receiver proper; otherwise the tone is affected. If any trouble is encountered with feed-back due to input and output wires being in close proximity to each other at the switch, it can be eliminated simply by addition of a 0.01-μfd. by-pass condenser from one side of the output transformer to ground of the receiver.

In the case of other types of amplifiers or receivers which do not have permanent-magnet type dynamic speakers and output transformers for such speakers, it is a simple matter to use a 0.1-μfd. condenser off the plate of any amplifier — or receiver — output tube to magnetic speakers, which work quite well although the p.m. type is better for this purpose.

An anti-capacity switch is not absolutely necessary. A knife or rotary switch is practical so long as feed-back from input and output circuits is not excessive due to close spacing of contacts.

As for volume and pick-up, this system is quite adequate for the purpose. Sounds 50 to 100 feet and more from the remote speakers can be heard plainly.

One remote speaker located at the door and one in another part of the house connected to this switching system saves quite a few steps, as well as time, in the course of a day. — *Ben J. Hummel, W8PCQ.*

—···—

A TWO-WAY INTERCOM

Believe it or not, there is a "Little Rock" in the central Pacific ocean which boasts a modern intercommunication system. The circuit diagram of the "Mechanical Rat," as we call it, is shown in Fig. 1110. I designed it and built it from such parts and tubes as were available for our use. While I am not at liberty to disclose the specific types used, the principle and the circuit are in no way restricted, and it will operate very satisfactorily with the tubes and constants shown in the diagram.

The 5-inch Permamag speakers serve also as microphones. We are using only two, although a larger number can be employed by connecting them through a single-pole multithrow switch as indicated in the diagram. The transformers, T_1 and T_2, are identical output transformers, although the impedance-match at the input end of the circuit no doubt would be better if a transformer with a higher-impedance primary were used.

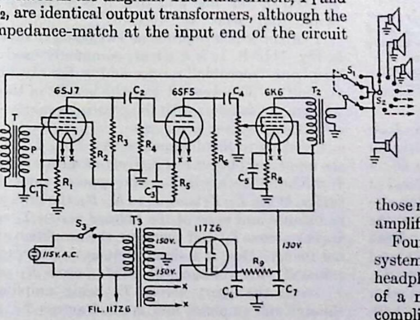


Fig. 1110 — Circuit diagram of the GI two-way intercommunication system showing equivalent civilian components.

C_1, C_3, C_5 — 0.1-μfd. paper.
C_2 — 0.05-μfd. paper.
C_4 — 0.01-μfd. paper.
C_6, C_7 — 40-μfd. 150-volt electrolytic.
R_1 — 1000 ohms, 1-watt.
R_2 — 47,000 ohms, 1-watt.
R_3, R_4 — 100,000 ohms, 1-watt.
R_5 — 3300 ohms, 1-watt.
R_6 — 15,000 ohms, 1-watt.
R_7 — 0.5-megohm potentiometer with switch.
R_8 — 220 ohms, 1-watt.
R_9 — 120 ohms, 2-watt.
S_1 — D.p.d.t. switch with spring return.
S_2 — Multi-point rotary wafer switch.
S_3 — S.p.s.t. switch on R_7.
T_1, T_2 — Identical output transformers to match 6K6 to speaker.
T_3 — Midget power transformer, 150 volts each side of center tap.

If, as in our GI version of the circuit, all fixed resistors are of 1-watt rating, it becomes necessary to parallel two of them for the filter resistor, R_9. A 200-ohm and a 300-ohm resistor were used in parallel at this point in the original model. The circuit values given are not to be considered ideal in each case, as this was a rush job and, since the system is in constant use, we have little time to experiment with it. The gain and fidelity are sufficient for our purpose.

Some economy would result from replacing the present power supply with a half-wave rectifier circuit and an *RC* filter. The tubes would be a 45Z5 rectifier, 12SJ7, 12SF7 and 50L6. The heaters could be connected in series without any need for a dropping resistor.

If the equipment is to operate in the field of a transmitter, it is best to shield the lines to remote stations of the system. Otherwise, distortion is apt to be present. — *Pfc. William H. Hull, APO 457, c/o Postmaster, San Francisco.*

—···—

INTERCOM SYSTEMS BETWEEN STATION AND FAMILY

An intercommunicating telephone system can hardly be classed as amateur radio equipment. We have discovered, nevertheless, that a surprisingly large number of amateurs consider it an essential part of the station. It may not add a mile to the range of the transmitter, but it often preserves peace in the household when it becomes necessary to communicate with the operator when the station is located in some remote corner of the house or in a shack in the back yard.

The solutions include descriptions of both the simple telephone systems and those more complicated systems employing speech amplifiers and loudspeakers.

Four different schemes for simple telephone systems are shown in Fig. 1111. In each case a headphone unit is used for the transmitter instead of a microphone. In view of this, those more complicated systems requiring microphones, batteries and transformers were eliminated.

The simplest idea submitted was that of Winfred C. Lowe, of New Brunswick, N. J. It is shown at (A) in Fig. 1111. The system operates with only a single wire and ground connection. The 60-cycle "buzz" in the single headphone at either end, when either push-button is operated, is used for calling. The size of the series condensers may be varied to produce the best results. The single-headphone unit is used both as microphone and receiver. The 115-volt lamps are used as a precaution against short circuits. Care should be taken to arrange the 115-volt plug so that the grounded side of the 115-volt line is connected to ground to prevent a short-circuit of the line. The danger of a short-circuit if the 115-volt plug is reversed could be eliminated by placing another fixed condenser between the 115-volt line and ground. The battery indicated for energizing the talking circuit is not always necessary.

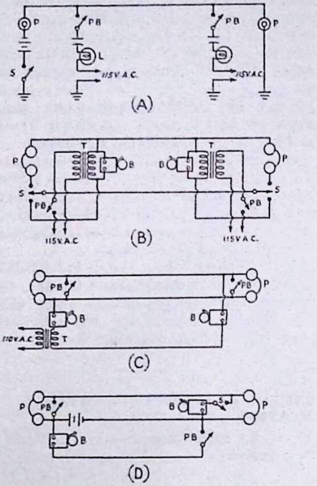


Fig. 1111 — Simple line telephone circuits. In most cases the system will work satisfactorily if a good ground connection is substituted for one of the talking lines. *B* — battery, bell or buzzer, as indicated; *L* — 115-volt lamp; *P* — headphone unit or set; *PB* — push-button switch; *T* — bell-ringing transformer.

Several ideas requiring two and three lines are included. When using but two wires (or one wire and a common ground, such as a water pipe), a power supply is required at each end of the line for ringing, as shown at (B). Switches also are required at each end to switch from the ringing circuit to the talking circuit. Both switches are normally thrown in the downward direction. With the switches in this position, either push-button may be used to call the other station. When the second station answers, both switches are thrown in the upward position for talking, after which the switches must be returned to the original position. In this particular case, bell-ringing transformers are used to supply the calling circuit. Ordinary headphones are used at each end, one unit being used at each end as the microphone. This particular arrangement was described by J. T. Simpson, New Orleans, La., although very similar schemes were suggested by several others.

A three-wire system requiring but one supply is shown at (C). This circuit, submitted by W9TO, has the advantage that no switching is necessary.

The circuit suggested by W9DFD, and shown at (D), is rather novel in that the same battery is used for both ringing and talking circuits. The switch at one end is normally closed to complete the ringing circuit. In the arrangement described, this is a hook-type switch on which the headphones are hung. It opens when the headset is removed from the hook for talking.

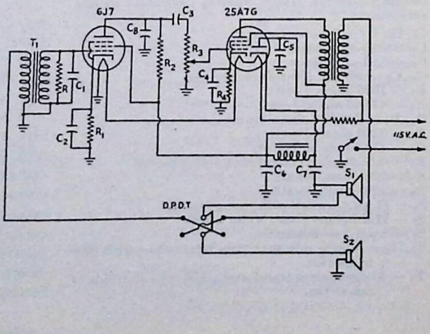
Turning to more elaborate installations of the speech-amplifier-loudspeaker variety, a popular circuit is shown in Fig. 1112. This circuit was supplied by Harry Moreton, jr., of Cincinnati, Ohio. The 25A7G is similar to the 12A7 and includes a rectifier for the power supply. The capacity of C_8 may be changed to suit personal preference as to tone quality. The chief disadvantages of this type of circuit are that it may be operated from only one end of the line and that it is necessary to switch from "send" to "receive."

A circuit which requires no switching is shown in Fig. 1113-B. It is a circuit commonly used in telephone "repeater" service and is described by G. Smith of Chicago, Ill. For the benefit of those who are not familiar with the principles involved, a brief explanation is given.

Referring to the diagram at (A), T_1 and T_2 are the input and output respectively of the amplifier. It will be noted that they are on opposite sides of a bridge. When Z_1/Z_2 is equal to R_1/R_2, the bridge is in balance and none of the voltage across T_2 can appear across T_1, and therefore the amplifier will not "sing." But, if a signal voltage is impressed across Z_1, the voltage will divide across R_1 and T_1, with that part across T_1 being amplified through the amplifier and applied across T_2. As

Fig. 1112 — Loudspeaker system including power supply.

C_1 — 0.001-μfd. mica.
C_2, C_3 — 0.1 μfd. 200-volt paper.
C_4 — 10 μfd. 25-volt electrolytic.
C_5 — 0.01 μfd. 200-volt paper.
C_6 — 16 μfd. 200-volt electrolytic.
C_7 — 12 μfd. 200-volt electrolytic.
C_8 — 0.001-μfd. mica.
R, R_2 — 100,000 ohms, ½-watt.
R_1 — 10,000 ohms, 1-watt.
R_3 — 0.5-megohm variable.
R_4 — 600 ohms, 5-watt.
R_5 — 290-ohm Candohm or Ohmite resistor cord.
T_1 — Line-to-grid transformer.
T_2 — Plate-to-line transformer.
S_1, S_2 — Magnetic speakers.
S — D.p.d.t. switch.



T_2 is in balance with *T_1* through the bridge, it will not feed back, but the signal voltage appearing across *T_2* will be impressed across *Z_1* and *Z_2* in series.

A practical circuit is shown in Fig. 1113-B. Comparing this with Fig. 1113-A, *Z_1* and *Z_2* are permanent-magnet speakers which serve as microphones as well. *R_1* and *R_2* are the same arms of the bridge as those correspondingly numbered in Fig. 1113-A and are supplemented by the potentiometer, *R_7*, for balancing the bridge. *R_3* is a gain control for adjusting the output of the amplifier. *T_1* should have a step-up ratio. *T_2* should have characteristics suitable for matching the load consisting of *Z_1* and *Z_2* shunted by the series of *R_1*, *R_2* and *R_7* to the optimum load specified for the output tube used. With speakers of about 5000 ohms and resistors *R_{11}*, *R_7*, and *R_2* respectively of 10,000, 5,000, and 10,000 ohms, *T_2* should have a ratio of about one-to-one to provide a proper load for the 6F6. The two speakers to be used in the system should be as nearly identical in their characteristics as possible.

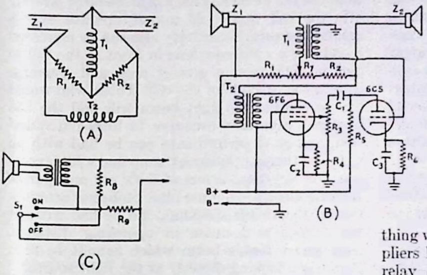


Fig. 1113 — A loudspeaker system which requires no switching.

C_1 — 0.01-μfd. 400-volt paper.
C_2, C_3 — 25-μfd. 25-volt electrolytic.
R_1, R_2 — 10,000 ohms.
R_3 — 0.5-megohm volume control.
R_4 — 400 ohms.
R_5 — 50,000 ohms.
R_6 — 2500 ohms.
R_7 — 5000 ohms.
R_8 — 5000 ohms (see text).
R_9 — 10,000 ohms.
T_1, T_2 — See text.

If, for any reason, either speaker needs to be cut out, a double-pole double-throw switch is necessary to remove the speaker and replace it with a resistance equal to the speaker impedance. If this is not done properly, the bridge will become unbalanced and the outfit will "sing." A single-pole double-throw switch in series with resistance can be used, as shown in Fig. 1113-C, to cause the circuit to feed back and "sing" which may be useful in calling. *R_8* and *R_9* are placed in each terminal set along with *S_1*. When *S_1* is closed, both speakers are muted somewhat due to the shunt of *R_8* and the voltage-dividing action of *R_9*. But when the switch is changed to the "on" position, the bridge will unbalance and "sing" until the other switch is thrown to the "on" position. *R_8*, at the operator's position, should be made variable to allow an additional bridge balance when both switches are in the "off" position. A similar change in both lines will not affect the balance, and therefore one of the shunting resistors may be made variable to compensate for the irregularities of the other.

If it is desired to be able to turn the amplifier on from either end of the line, it will be necessary to run another pair of lines between the two stations with both switches connected in parallel across the line.

* * *

A SIMPLE, RELIABLE AND INEXPENSIVE PHOTOTUBE RELAY

The irresistible urge to be doing something with a soldering iron and a pair of long-nose pliers has resulted in the very simple phototube relay circuit shown in Fig. 1114. This circuit seems especially appealing, since it does not require material that is critical or otherwise difficult to obtain. Most ham shacks could supply parts for two of these units by looking behind the work-bench. The relay used for controlling the external circuit need not be especially sensitive, and good results can be expected from one constructed from odds and ends; for instance, the poles and coils from a discarded high-impedance headphone. The circuit shows a meter in the plate lead of the tetrode. This was included to make comparisons between photocells and light intensities. This meter can and should be left out of the circuit.

The compact 117L7GT was used because of its dual-purpose features. By employing the diode portion in a half-wave rectifier circuit, reasonably smooth d.c. voltage is available for the operation of the amplifier section of the tube. This arrangement also eliminates the condenser used across the relay in self-rectifying types of photocell-relay circuits. The 117-volt filament makes unnecessary the use of dropping resistors or ballast tubes. While the 117L7GT seems to be the logical tube to use, there is no reason why a separate rectifier or amplifier tube could not be used if a 117L7 is not under the work-bench. The photocell is an RCA 868. The author is a theater projectionist and finds discarded 868s relatively numerous. Almost any projectionist would be glad to donate a discarded photocell to a ham, if only to keep him from collecting butterflies for the duration. The discarded cells are not necessarily "duds." In theater amplifiers the gain is usually rather high, on the order of 125 db. Consequently, a cell which is low is usually discarded rather than having to lower the sensitivity of the remaining cell and then raise the gain of the amplifier. The discarded cell is usually far from being useless.

Here is how the circuit works. The power supply delivers d.c. at a voltage depending on the capacity of *C_1*. The condenser value shown was used because it happened to be the highest value on hand. If experience shows the cell being used to be free of excessive gas, the plate voltage could be raised by using a 40-μfd. tubular condenser rated at 200 volts. The 868 cells are rated for 90 volts of applied potential. New cells often glow at this voltage, while on the other hand a "hard" cell can be operated at 135 volts without glow. All cells have some gas introduced to assist the electron transit from the cathode to the anode and to increase the sensitivity by secondary emission, so beware when increasing the supply voltage. Do not expose the cells to direct sunlight. If they are used out of doors in the daytime, efficient shielding will be required to exclude all but the operating light beam. Ionization within a cell is indicated by a faint glow, purple in color. When this takes place you have a VR tube instead of a photocell. With as poor a cell as could be found, the plate current of the amplifier could be driven as high as 12 ma. with sufficient light to reach the saturation point of the cell.

To select the proper value of R_3, the drop-out current of the relay to be used should be determined by performing the following experiment. With the photocell removed from the socket, try increasingly higher values of resistance, starting with 1000 ohms, until the relay will no longer stay locked up when the armature is pressed toward the pole face with the finger. Adjusting the resistance value closely will give a plate current just under the release-point of the relay. This allows the relay to operate by itself when the plate current is increased by the application of light after the photocell has been inserted in the socket, since increased light reduces the bias on the grid of the control section of the tube. The amount of plate-current increase necessary is the difference between the pick-up and drop-out values, plus the difference between the static and drop-out values. By narrowing down this difference to as small a value as possible without making the relay action sluggish, good sensitivity and quick action are insured. This action can be more easily understood if it is realized that the photocell is in reality a variable resistor between the positive end of the power supply and the grid of the tube. More light in the cell simply overcomes the negative bias applied through R_1.

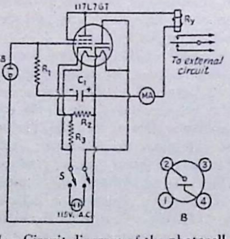


Fig. 1114 — Circuit diagram of the photocell relay.

C_1 — 16-μfd. 450-volt. electrolytic.
R_1 — 10 megohms, ½-watt.
R_2 — 25,000 ohms, ½-watt.
R_3 — See text.
Ry — 1000-ohm (approx.) relay.
M — 0–15-ma. d.c. meter.
S_1 — D.p.s.t. switch.
B — Base connections for 868, bottom view.

In the dark, a two-cell focusing-type flashlight gave positive operation at a distance of 28 feet. A stronger light source with a simple lens to direct the filament image of the source directly into the cell would, of course, operate over a greater distance. Sensitivity also can be increased by adding a condenser lens in front of the cell to pick up light over a greater area and converge it onto the cathode of the cell. Those who would like to conceal the light beam will find the 868 photocell especially sensitive to infra-red radiation, and good performance can be had with an ordinary tungsten-filament lamp and a filter composed of alternate layers of dark red and purple gelatine sheet. Do not use blue. Sufficient attenuation of the visible spectrum can be had without too serious a decrease in operating distance, using the invisible beam which cannot be seen even when looking directly at the light source.

This circuit, with the relatively slow-operating telephone-type relay employed, followed keying accurately at 20 w.p.m. when the light beam was completely interrupted. The relay should have a single-pole double-throw arrangement of contacts so that an external circuit can be completed or broken when the light is applied or removed.

Go ahead and open your garage doors with it, too; we don't care. — *John T. Seiler, W6TGD.*

A "LIGHT-BEAM" TRANSMITTER AND RECEIVER

SEVERAL years have passed since the writer first became interested in the possibilities of "talking" over a beam of light, but nothing was done about it until the XYL persuaded me, against my better judgment, to give a talk before the local women's clubs, on the general subject of radio.

It was while digging up things to amuse the ladies that the old interest was revived, and we decided to give it a try. A bit of experimenting gave results far better than expected, and distances up to 100 feet were covered without any noticeable decrease in volume. Excellent results were obtained even in broad daylight.

In building the outfit, our first consideration was that of cost. Discarded radio parts had to be used whenever possible, and the final rig contained nothing in the way of new equipment except the photocell in the receiver. Even if all the parts were to be purchased, the costs should not run too high.

The neon-tube and light-sensitive-cell circuits are shown in Fig. 1115.

The receiver is simply a high-gain amplifier with about 5 watts output. Your preamplifier should do the trick nicely. We found it convenient to mount the amplifier, speaker and photocell in an old portable radio case. This made it necessary to shield carefully the photocell and first tube in the amplifier with double shield cans.

The space between the cans was painted black and a half-inch hole cut in one side to admit the light. In order that the rig could be used in anything but total darkness, a tube about 5 inches long, painted black inside, was mounted so that the light to the cell must pass through it.

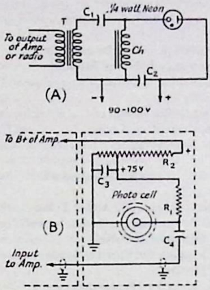


Fig. 1115 — (A) circuit of neon-bulb generator on transmitting end fed by microphone, phono-pick-up or radio through suitable audio amplifier. C_1 should be 0.5 to 2 μfd., C_2, 8 μfd. *Ch* is a 30-henry audio choke.

(B) photocell pick-up on receiving end feeding loudspeaker through suitable audio amplifier. R_1 is a 500,000-ohm resistor. C_3, 8 μfd. electrolytic, and C_4, 0-5-μfd. paper. R_2 is a voltage divider of usual value.

The photocell and its own voltage divider were mounted in and on a separate chassis, so they were shielded from the rest of the amplifier, and a shielded lead (as short as possible) was run to the control grid of the first tube. The voltage on the cell is not critical and may be anything from 45 to 90 (we used about 75), but this must be as nearly pure d.c. as possible. Batteries were first used, but the arrangement shown in the drawing gave good results without hum.

The cell itself, a Cetron Type CE-2, selling at $5.40 (prewar price), was chosen for its small size. However, any cell of the type used in movietone work should work as well.

The transmitter consists of a source of light and a method of modulating that light. It was here that we were stumped for a time. Millen and Kruse, in their booklet, "Below Ten Meters," give a circuit for such a device, but we didn't have a "Zetka" recording lamp and did not know where to get one. However, after considerable experimenting we found that a 35¢ ¼-watt neon lamp, such as those used in tube testers and other service equipment, would do very nicely. This may seem low power, but its small size makes it possible to focus the beam and get almost perfectly parallel rays. A reflector, such as those used in automobile spot lights (from the nearest junk yard), and a double-lens system obtained from an old post card projector made the system complete. A large reading glass at the receiver serves to focus the rays on the photocell.

The modulator is practically the same as that shown in "Below Ten Meters," but the input transformer is an old 3-to-1 audio, and the choke is a 30-henry model from an old radio. Also, the ignition voltage for the lamp was obtained directly from the "B" supply of the amplifier. The polarity of this ignition voltage does not seem to matter, but the condenser should be poled right if it is of the electrolytic variety.

The modulator may be fed from a radio receiver for experimental work, but since we wanted to talk over the light beam ourselves, an amplifier was made from the audio portion of a discarded four-tube t.r.f. a.c.-d.c. midget. The tuning condenser, r.f. coils and r.f. tube were removed and the detector revamped to act as the first audio. This was connected to input transformers to match a single-button microphone and phonograph pick-up and a switch was mounted so that either source could be used at will.

The rig will work as far as you can shine the light, so it simply becomes necessary to concentrate the beam into parallel rays to duplicate our results. Only a small amount of light is necessary and, if you have as good luck, you will have to turn down the volume to prevent overloading the receiver. — *L. W. Floorman, W8RWP.*

* * *

A CARD INDEX FOR YOUR QSOs

THE practical value of a card index file for recording all QSOs is generally recognized, but some hams may associate the idea with a lot of hard work and drudgery.

If a workable system is used, little extra effort is required because the cards may be filled out during a QSO. Since this system takes care of a lot of the information usually recorded in the log, we may say there is no *extra* work involved!

The cards, 3 × 5 inches, ruled on one side, may be obtained in any dime store. On the top line of the card, left to right, is placed — the call, the QTH and the sine or "handle." On the second line we place his frequency and "ARRL — ORS —" etc. Dope on the QSL is marked "QSL R/S," "R" meaning received and "S" meaning sent.

Personal information is recorded on the back of the card. It might read something like this, ". . . Age, 34 (1940); married; 12 kids; manager, Hayseed Hogwash Co.; ham since '27; 6L6, 25-w.; 3-tuber. Hunts, fishes, and likes gooseberry pie. . . ." You wouldn't have any trouble remembering a former QSO with that fellow if you had that data to freshen your memory.

Now, we must place the cards alphabetically in a file using tabs to indicate the location of the cards for each district. The dime store sells these tabs, but since they are marked "A" to "Z," it is necessary to turn them over and mark them "W3," "W5," "W9," "VE," "ZL," etc.

We have so much information on the cards that it is no longer necessary to put the QTH and other dope in a log.

Once this system is put into use, we would not consider parting with it. The index was started at W9FB in 1936. It grew until it now includes over 1900 cards covering over 5000 QSOs. One can spend many an interesting hour browsing through a file of this kind. — *Amos Utterback, W9FF*

Index

PAGE
A.C. or Battery Power Supply 52
A.C. Generators, Gas-Driven, Simple Checks on 60
Antennas:
  112 Mc., an Inexpensive Mounting for 95
  112 Mc., Investigating the Performance of 95
  112-Mc. Mobile, Collapsible Rotary Beam 94
  Array, 112-Mc., Mounting for 95
  Car-Roof, for V.H.F. 90
  Coaxial Dipole, Feeding with Open-Wire Line 92
  Concentric, Shatter-Proof Insulator for 94
  Elements, Insulated Mounting for 82
  Halyard, Replacing the 78
  Lazy-H, a Flat Line for 67
  Lightning Protection of 83–84
  Low-Frequency, for Emergency 72
  Mounting, Universal Angle for V.H.F. 93
  Multiband End-Fed 68
  Portable, 112-Mc., Three-Element 92
  Pulley, Substitute for Antenna 78
  Pulleys, Information on Antenna 78
  Shunt-Fed Mobile 91
  Six-Element Array for 113 Mc. 90
  Three-Band Automatic 67
Antenna Systems:
  Delta-Match, Adjusting from Ground 69
  Feeder Tuning Indicator 70
  Feeder Tuning, Series-Parallel 77
  Feeders, Prevention of Tangling 82
  Feeders, Rain-Drip Wires for 77
  Feeders, Tension in Building of 82
  Fixed Position, Three-Element Beams 70
  Half-Wave Doublet on Second Harmonic 70
  Halyard, Antenna, Replacing 78–79–80–81
  Insulators for Rotary Beam Elements 82
  Lazy-H, a Flat Line for 67
  Low-Frequency, for Emergency 72
  Low-Impedance, a Matching System for 68
  Mast, a Light Hollow 73
  Mast, a Fifty-Footer with no Guy Wires 75
  Mast, an Inexpensive 50-Foot 73
  Mast, Easy Way to Raise 76
  Mast, Raising With Ladder as Gin Pole 77
  Multiband End-Fed 68
  Pulley, a Substitute for Antenna 78
  Pulleys, Information on 78
  Rhombic, Incorrect Use of 115-Volt Lamps in 69
  Rotable Antennas, Feeding of 71
  Three-Band Automatic 67
Attenuator, for Receiver Audio 22
Autotransformer, Improved 55

B.C. Interference Elimination 31
Battery or A.C. Power Supply 52
Band-Change Switch 36
Bandspread to General Coverage Change-Over 18
Band Checker 107
Battery-Operated Receivers, Protective Device for 23
Bias, Maintaining Constant on Keyed Stage 102
Bias Supply for R.F. Amplifier 51
Bias Supply for "Zero Bias" Modulators 62
Blocked-Grid Oscillator Keying 102
Boosting Transformer Voltage 53
Brass, Making Shim Brass from Spring Brass 12
Break-In and Keying Monitor System 98

PAGE
Break-In Operation with a Dynamotor 61
Break-In System and Keying Monitor 98
Bridge for Checking *C* and *R* 108
Bug, Anchoring a 97
Bug Key, Improving Action of 102
Bulbs, Pilot, Current vs. Color 105
Buzzer Tone, Improving 109

C.W. Selectivity Using Regenerative Audio Amplifier 16
Cable Connectors from Old Metal Tubes 60
Cable Plugs, Power Supply, Design for Safety 58
Calibrating Oscillator, 100-Kc. 107
Capacity, Changing for Various Bands 30
Card Index for QSOs 123
Cards, QSL, Ideas for Displaying 116
Chassis Connections, Plug-In 38
Chassis Connections, Safety Precautions 57
Chassis Terminals, Exposed H.V., Shield for 57
Chest Used to House Transmitter 115
Class-B Modulators, Self-biasing System for 49
Clips, Coil, Non Short-Circuiting 34
Clothes-Closet Transmitter Housing 115–116
Code Instruction, Wiring Harness for Classroom 112
Code Practice:
  Battery Oscillator, Filament Jack for 110
  Buzzer Tone, Improving 109
  Code Instruction, A Portable Wiring System 112
  Code Machine, Homemade 112
  Code Tables, Curing Cross-Talk in 111
  Oscillator, A.C.-D.C. 110
  Oscillator, Sure-Fire 109
  Oscillator, Transformerless 110
  Oscillator Using B.C. Receiver 109
Code Practice Machine 112
Code-Practice Oscillator and Keying Monitor 101
Code Practice Oscillators 109–110–111
Coil Clips, Non Short-Circuiting 34
Coil, for Three-Band Operation 30
Coils, Winding of Small Self-Supporting 12
Coils, Winding on Polystyrene Forms 12
Condenser and Resistor, Bridge for Checking 108
Condensers, Band-Set, Automatic Stop for 17
Condensers, Electrolytic, Rejuvenating 62
Condensers, Filter, Discharging Relay or Switch 65
Condensers, Filter, Discharging Tool 58
Condensers, Neutralizing, Homemade 35
Condensers, Trimmer, Mounting of 35
Connections, Chassis, Plug-In 38
Connectors, Cable, from Old Metal Tubes 60
Control for High-Power Rigs 43
Control of Plate Voltage with Combination Transformer 59
Control, Power, with Autotransformer 54
Control, Simple Line-Voltage 66
Control, Single Switch System 44
Control Unit, Transmitter 56
Controls, Volume, Ganging 24
Converter, V.H.F. and U.H.F., Crystal Detector 86
Cross-Talk, Curing in Code Practice Tables 111
Crystal Filter for 'Phone Work 19
Crystal Holder, Multiple 37
Crystal Holder, Variable Frequency 44
Crystal Oscillator and a Meter Substitute 27

PAGE
Crystal Oscillator, Composite 26
Crystal Oscillator, Pierce, Getting Results with 25–29
Crystal Oscillator, with Variable Frequency 28
Crystal Selector Switch 37
Crystal Socket, Three-Way 38

Delta-Match System, Adjusting from the Ground 69
Detector, Infinite-Impedance, a Push-Pull 20
Discharging Tool for Safety 58
Display of QSL Cards, Ideas for 116–117–118
Doublet, Half-Wave, on Second Harmonic 70
Drilling Glass, Porcelain and Pyrex 11
Drilling Hints 9
Drilling Tubing and Rods 10
Drills, Starting Tool for 11
Dust-Protection in Transmitter Construction 115
Dynamic Speaker to Replace Magnetic 17
Dynamotor Used for Break-In Operation 61

E.C.O. Drift, Notes on 28
E.C. Oscillators, Keying 97
Electrolytic Condensers, Rejuvenating Method 62
Emergency Low-Frequency Antenna 72

Feeder, Rain-Drip Wires 77
Feeder Tuning 77
Feeder Tuning Indicator 70
Feeders, Open-Wire, Prevention of Tangling 82
Feeders, Tension Aids Building of 82
Feeding Continuous Rotable Antennas 71
Field Strength Meter for V.H.F. Work 96
Filament Hum Elimination 33
Filament Rheostat, Cheap 56
Filament Voltage: 6.3 v. from 5-v. Winding 53
Filament Voltage: 6.3 v. from 2.5-v. Windings 55
Filament Voltage: 6.3 v. from 7.5-v. and 2.5-v. Windings 54
Filter-Discharging Relay or Switch 65
Filter, Key-Click 98
Filtering Genemotors Used to Supply Receivers 61
Flanges for Support of Rack Units 35
F.M. Receivers, a Resonance Indicator for 24
Frequency, Crystal, Lowering of 36
Frequency Meter, with Monitor and Keying Osc. 106
Frequency Stability, HRO Receiver Improvement 21
Frequency Standard, Simplified 108
Fuses, Cartridge-Type, Insulated Holder for 58

Genemotors, Receiver, Filtering 61
General-Coverage to Bandspread Change-Over 18
Generators, Gas-Driven A.C., Simple Checks on 60
Grid-Plate Oscillator, Harmonic 29
Grounding Positive High Voltage for Safety 64

Halyard, Antenna — Replacing the 78–79–80–81
Harmonic Operation of Half-Wave Doublet 70
Headphones, Air Vent for Earpiece 22
Headphones, Connections for, in B.C. Receiver 22
Headphones, Cord, Prevention of Twisting 24
Headphones, Parallel Feed for 59
Hetrofil Snags and Their Solution 15
Hetrotone Circuit 18
High-Voltage Positive Lead, Grounded for Safety 64
Holder, Magnetic, for Nuts and Lock Washers 9
Holder, Insulated, for Small Cartridge-Type Fuses 58
Holes, Chassis, Cutting Square 9
Hum, Filament, Elimination of 33

I.C.W. for V.H.F. Transmitter 86
I.F. Shift Eliminated, Hetrotone Circuit 18
Illumination of Meters 42
Index, Card-Type for QSOs 123
Insulation for Antenna Elements in Rotary Beam 82

PAGE
Insulators for Concentric Antenna, Shatter-Proof 94
Insulators, Stand-Off 36
Intercommunication Systems 118–119
Intercom System from Receiver or Audio Amplifier 118–119
Intercom Systems Between Station and Family 119
Intercom, Two-Way 119
Interference, Eliminating from Gas-Driven Plant 60
Interference, BCL, Elimination of 31–32
Interference, Eliminating Noise from Transmitter 32
Interlock, Sure-Fire 40

Key-Click Elimination, Circuit for 98
Key-Click Filter 98
Keying Circuit, Anti-Blinking 97
Keying Circuit, Oscillator, for Chirp Elimination 97
Keying E.C. Oscillators 97
Keying and Monitoring:
    Blocked-Grid Oscillator Keying 102
    Break-In and Keying Monitoring Systems 98–99–100
    Bug, Improving at Lower Speeds 102
    Bug Key, Anchoring 97
    Click Elimination, Oscillator Keying Circuit 98
    Click Filter 98
    Code-Practice Oscillator and Keying Monitor 101
    Constant-Output Keying System 102
    E.C. Oscillators, Keying 97
    Grid Bias Voltage Used in Monitor 100
    Mixing, Electronic, for Monitoring 101
    Relays, Keying, Cheap 97
    R.F. Used to Excite Monitor 101
Keying Monitor 101
Keying Monitor and Break-In System 98–99–100
Keying Monitor and Code Practice Oscillator 101
Keying-Monitor System 100
Keying, Oscillator, Blocked Grid 102
Keying, Oscillator, for Click Elimination 98
Keying Oscillator, with Freq. Meter and 'Phone Monitor 106
Keying Systems, Maintaining Bias Constant on Keyed Stage 102
Keying Systems to Prevent Drop in R.F. Output 102

Lamps, 115-Volt, for Terminating Rhombic 69
"Light-Beam" Transmitter and Receiver 122
Lightning, Protection from Damage by 83–84
Line Polarity, Properly Made with Special Plug 66
Line-Voltage Control, Simple 66
Loktal Tubes, Removal of Bases 87
Low-Frequency Reception, Hints on 22–23
Low-Impedance Radiator, Matching System for 68

Magic Eye as A.F. Push-Pull Balance Indicator 15
Magnetic Speaker Replaced by D.C. Dynamic 17
Mast, 50-Foot, an Inexpensive 73
Mast, 50-Foot Using No Guy Wires 75
Mast, a Light Hollow 73
Mast, Easy Way to Raise 76
Mast, Raising With Ladder for Gin-Pole 77
Matching System for Low-Impedance Radiator 68
Metal Tubes, Cable Connectors from 60
Meter Boxes, Used for Portable Mountings 105
Meter Switching, Simplified 103
Meter Switching, To One of Three Circuits 105
Meter Switching with Toggle Switches 41
Meters, Illumination for 42
Microphone Current for Portable Transmitters 33
Mixing, Electronic, for Monitoring 101
Mobile Antenna, 112-Mc. Collapsible Beam 94
Mobile Antenna, Shunt-Fed, V.H.F. 91
Modulation Indicator and Field Strength Meter 49
Modulation Indicator, Simple 46
Modulation Flash Indicator for Peaks 46
Modulator, Simple Type for Portable Work 48

PAGE

- Modulators, Self-Bias System for Class-B....... 49
- Modulators, "Zero Bias," Grid Voltage......... 62
- Monitor, Keying from Transmitter Bias........ 100
- Monitor, Keying from Transmitter R.F. Pick-Up. 101
- Monitor, Keying, and Break-In System......... 98
- Monitor, Using Infinite-Impedance Detector.... 45
- Monitoring, Electronic Mixing for............. 101
- Monitoring 'Phone with Receiver R.F. Stage Only. 46
- Monitoring 'Phone with 'Scope Having No Sweep Circuit.............. 46

- Neutralizing Condenser, Homemade........... 35
- Neutralizing, Obtaining Proper Capacity for.... 30
- Neutralizing, Reducing Hazards of............ 39–40
- Neutralizing, Using Receiver as Indicator....... 42
- Neutralizing, Using Voltmeter as Indicator...... 38
- Neutralizing with a Modulation Monitor........ 30
- Noise from Transmitter, Elimination of......... 32
- Noise-Limiter for V.H.F. Mobile Receiver....... 87
- Noise-Limiter, Series, with Plate Detectors...... 13
- Noise-Limiter, Simple 6H6 13

- Open-Wire Feeders, Prevention of Tangling..... 82
- Open-Wire Feeders, Tension Aids Building of.... 82
- Open-Wire Line, Feeding Coaxial Dipole with.... 92
- Operating Position, Rack Style................ 114
- Oscillator, 6E5, in Crystal Circuit.............. 27
- Oscillator, 100-Kc., Extending Usefulness of..... 104
- Oscillator, Calibrating, 100-Kc................ 107
- Oscillator, Code Practice and Keying Monitor.. 101
- Oscillator, Code Practice, Filament Jack for..... 110
- Oscillator, Code Practice, Simple A.C.-D.C...... 110
- Oscillator, Code Practice, "Transformerless".... 110
- Oscillator, Code Practice, Using B.C. Audio for... 109
- Oscillator, Composite Circuit.................. 26
- Oscillator, E.C., Notes on Drift in............. 28
- Oscillator, Grid-Plate for Fund. and Harmonic... 29
- Oscillator, Harmonic, Circuit................. 26
- Oscillator Keying Circuit for Click Elimination... 98
- Oscillator, Sure-Fire Audio.................. 109
- Oscillator, Simple Test...................... 107
- Oscillators, Keying E.C...................... 97
- Oscilloscope Coupling to 'Phone Rig........... 45
- Overload Protection for Equipment........... 63
- Overload Protection, Automatic, for 807 Tubes... 42
- Overload Relay, Non-Chattering.............. 41
- Overmodulation Indicator 47

- Parallel Feed in Grid and Plate R.F. Circuits.... 31
- Peak-Limiter for Speech Amplifier............. 50
- 'Phone:
  - Audio Peak Limiter for Speech Amplifiers... 50
  - Monitor Using Infinite-Impedance Detector.. 45
  - Monitoring Kink...................... 46
  - Modulation Indicator.................. 46
  - Modulation and Field Strength Meter...... 49
  - Modulation Monitor with Oscilloscope...... 46
  - Modulator for Portable Work........... 48
  - Negative-Peak Overmodulation Indicator .. 47
  - 'Scope Coupling...................... 45
  - Self-Biasing System for Class-B Modulators. 49
  - Shielding the Microphone Plug........... 50
  - Voice-Controlled Transmitter Switching..... 48
- 'Phone Monitor with Freq. Meter and Keying Oscillator.............................. 106
- Phototube Relay, Simple and Inexpensive....... 121
- Pierce Crystal Oscillator Circuit.............. 25–29
- Pilot Bulbs, Current vs. Color................ 105
- Plate-Voltage Control with Combination Trans... 59
- Plug, Cable, Safety Design for Power Supply 58
- Plug, Polarized for A.C.-D.C. Gear............ 57
- Polarity of Supply Line, Proper, Signal Light for.. 66
- Portable Transmitters, Microphone Current for.. 33

PAGE

- Positive High Voltage, Grounding for Safety..... 64
- Power Supply:
  - Autotransformer, Improved.............. 55
  - Autotransformer Used for Power Control.... 54
  - Battery or A.C. Pack.................... 52
  - Bias for R.F. Amplifier.................. 51
  - Bias for "Zero-Bias" Modulators.......... 62
  - Boosting Voltage by Replacing 83 with 866 jr.s 59
  - Cable Connectors from Old Metal Tubes ... 60
  - Chassis Connections, Safety Pointers on..... 57
  - Control of Power with Autotransformer..... 54
  - Control Unit, Safe and Economical......... 56
  - Discharging Tool, Filter................. 58
  - Dynamotor, Break-In Operation with...... 61
  - Electrolytic Condensers, Rejuvenating...... 62
  - Filament Rheostat, Cheap................ 56
  - Filament Voltage: 6.3v. from 5-v. Winding... 53
  - Filament Voltage: 6.3 v. from 5-v. and 2.5-v. Windings........................... 55
  - Filament Voltage: 6.3 v. from 7.5-v. and 2.5-v. Windings........................... 54
  - Filter-Discharging Relay or Switch......... 65
  - Filter Discharging Tool for Safety......... 58
  - Fuses, Small Cartridge Type, Insulated Holder 58
  - Gas-Driven A.C. Generators, Simple Checks 60
  - Genemotors, Used in Receivers, Filtering of.. 61
  - Headphones, Parallel Feed for............ 59
  - Interference, Eliminating from Gas-Driven Plant............................... 60
  - Line Polarity, Correct Connections for Safety 66
  - Line-Voltage Control, Simple............. 66
  - Overload Protection for Equipment........ 63
  - Plate Transformers, Dissimilar, Connecting .. 53
  - Plate-Voltage Control with Combination Transformer........................ 59
  - Plug, Polarized, for A.C.-D.C. Gear........ 57
  - Plugs, Design in Power Supply for Safety... 58
  - Positive High Voltage, Grounding for Safety 64
  - Protective Circuit for Power Tube......... 62
  - Relay, Inexpensive Time-Delay........... 66
  - Resistor Power Rating, Increasing......... 59
  - Safety in Chassis Connections............ 57
  - Series Operation of Stages from Power Supply 65
  - Switch, Safety, for Power Supply.......... 64
  - Switches in "B" + Lead 58
  - Terminals, Exposed H.V., Shield for........ 57
  - Voltage Regulation, Improved for Oscillator. 62
  - Voltage Regulation with V-R Tubes........ 52
- Power Control with Autotransformer........... 54
- Power Rating of Resistors, Increasing.......... 59
- Power Supply for Battery or A.C. Use.......... 52
- Power Supply Cable Plug, Design for Safety 58
- Power Supply Control Unit, Transmitter........ 56
- Power Supply, for Stages in Series............ 65
- Power Supply, Safety Switch for.............. 64
- Power-Tube Protective Circuit............... 62
- Preselector, Using SW-3 Receiver as a.......... 20
- Protection Against Lightning Damage.......... 83–84
- Protection of Equipment from Overloads....... 63
- Protection, Overload, Automatic for 807 Tubes... 42
- Protective Circuit for Power Tubes............ 62
- Pulley, Antenna, Substitute for............... 78
- Pulleys, Information on...................... 78

- QSL Card-Display Ideas.................. 116–117–118
- QSOs, Card-Type Index for.................. 123

- Rack Mounting for Dust-Protection........... 115
- Rack-Style Operating Position................ 114
- Rack Units, Support of, with Flanges.......... 35
- Radiophone, Radiotelephone (*see* "'Phone")
- Receiver:
  - 600-Meter Reception, Hints on 22

PAGE
  Air Vent Makes 'Phones More Comfortable. 22
  Audio Attenuator for Receivers 22
  Automatic Stop for Band-Set Condensers.... 17
  Bandspread or General Coverage Coils...... 18
  Battery Operated Receivers, Protection for.. 23
  Battery Tubes, Automatic Bias for 23
  Crystal Filter for 'Phone Work............ 19
  Eliminating I.F. Shift by Hetrotone Circuit.. 18
  Ganging Volume Controls................. 24
  Headphone Connections in B.C. Receivers... 22
  Hetrofil Snags and Their Solution.......... 15
  Hetrotone Circuit, Eliminating I.F. Shift.... 18
  Improving H.F. Oscillator Stability........ 21
  Magic Eye, As a Balance Indicator........ 15
  Noise Limiter Simple Type................ 13
  Phone-Cord, Prevention of Twisting........ 24
  Preselector Using SW-3 Receiver........... 20
  Push-Pull Infinite-Impedance Detector..... 20
  Receiver-Operated Relays................. 16
  Regenerative Audio Amplifier for C.W...... 16
  Regenerative Detector Receiver, One Tube.. 21
  Regenerative R.F. Stage Using 6L7........ 19
  Replacing Magnetic Speaker with Dynamic. 17
  Resonance Indicator for F.M. Receivers..... 24
  Second-Detector Circuit.................. 20
  Series Noise Limiter with Plate Detector.... 13
  Superheterodyne Operating Kink.......... 21
  Temperature Compensation to Reduce Drift. 14
  Tone Control by Negative Feed-Back...... 23
Receiver and Transmitter, "Light-Beam"...... 122
Receiver "B" Switch Connections............ 58
Receiver Drift, Temperature Compensation for.. 14
Receiver Genemotors, Filtering............... 61
Receiver, HRO, Improvement of Stability...... 21
Receiver-Operated Relays.................... 16
Receiver-Transmitter for 112-Mc. Band 89
Receivers, F.M., a Resonance Indicator for 24
Reception, 600-Meter....................... 22
Reception, 'Phone Using Crystal Filter......... 19
Regeneration Control......................... 19
Regenerative Audio Amplifier for C.W. Selectivity 16
Regenerative Detector, a Versatile............. 21
Regenerative R.F. Stage (6L7) 19
Regulation, Voltage, Improved with V-R Tubes.. 52
Regulation, Voltage, Improved for Oscillators.... 62
Relay or Switch for Filter-Discharge........... 65
Relay, Inexpensive Time-Delay................ 66
Relay, Overload, Non-Chattering.............. 41
Relay, Phototube, Simple — Inexpensive....... 121
Relays, Cheap, for Keying and Various Uses..... 97
Relays, Receiver-Operated.................... 16
Remote Control, Time-Delay Circuit........... 43
Remote Switching from Four Locations......... 40
Resistors and Condensers, Bridge for Checking... 108
Resistor Power Rating, Increasing............. 59
Resonance Indicator for F.M. Receivers........ 24
Rheostat, Cheap Filament.................... 56
Rhombic Antennas, Incorrect Termination of.... 69
Rotatable Antennas, Feeding of............... 71

Safety by Use of Discharging Tool............ 58
Safety, Polarity of Supply Line with Respect to... 66
Safety in Power-Supply Cable Plug Construction. 58
Safety Precautions in Chassis Connection....... 57
Safety — Reducing Neutralizing Hazards....... 39–40
Safety — Sure-Fire Interlock.................. 40
Safety Switch for Power Supply............... 64
Second Detector Circuit (6H6 in a Novel Circuit) 20
Selector Switch, Crystal...................... 37
Series Connection of Dissimilar Transformers ... 53
Series Operation from High-Voltage Power Supply 65
Shack:
  Cedar Chest Housing for Transmitter....... 115

PAGE
  Clothes-Closet Housing for Transmitter..... 116
  Dust-Protection of Equipment............. 115
  Intercom. Between Stations and Family..119–120–121
  Intercom. System from Receiver or A.F. Amp. 118
  Intercom., Two-Way..................... 119
  "Light-Beam" Transmitter and Receiver... 122
  Phototube Relay, Simple — Inexpensive 121–122
  QSL Card-Display Ideas.............. 116, 117–118
  Table, Radio, Designs for............... 113, 114
Solder, Handy Way to Roll.................. 7
Soldering-Iron Heat Control................. 7
Soldering-Iron Rest...................... 7–9
Soldering-Irons, 6-Volt..................... 8
Soldering-Iron Warning..................... 7
Soldering to Polystyrene Sockets............. 12
Soldering Tip for Tight Places............... 9
Soldering-Torch, Gas-Heated................ 8
Soldering-Torch, Improvised................. 7
Soldering Vise for Small Parts.............. 11
Speaker, D.C. Dynamic to Replace Magnetic.... 17
Speech Amplifier or Audio Oscillator for V.H.F. 88
Speech Amplifier, Audio Peak Limiter for....... 50
Stability of H.F. Osc. in HRO Rec., Improving... 21
Stages in Series Operating from H.V. Power Supply 65
Station-to-Family Intercom. Systems.......... 119
Stop, Automatic, for Band-Set Tuning Condenser 17
Subharmonic Elimination................... 31
Superheterodyne Receivers, for Three-Way QSOs 21
Supply Line, Polarity of, for Safety........... 66
Switch, Band-Change....................... 36
Switch Connection, for Receiver "B" Supply 58
Switch, Filter Discharge..................... 65
Switch, Safety, for Power Supply............. 64
Switch, Single, for Transmitter Control....... 44
Switching from Four Locations.............. 40
Switching, Meter, with Toggle Switches........ 41

Table, Radio, Design for..................... 113–114
Tank Circuit for V.H.F. Equipment............ 87
Terminals, H. V., Chassis Shield for........... 57
Test Equipment:
  Band Checker.......................... 107
  Bridge for *C* and *R* Checking............... 108
  Calibrating Oscillator..................... 107
  Current vs. Color of Pilot Bulbs........... 105
  Extending Range of 100-Kc. Oscillator...... 104
  Freq. Meter, 'Phone Monitor and Key. Osc.. 105
  Frequency Standard...................... 108
  Meter Boxes, a Use For.................. 105
  Meter Switching......................... 105
  Multirange V-O-M....................... 104
  Simplified Meter Switching............... 103
Test Oscillator (B.C. Receiver Alignment)....... 107
Test Oscillator, Simple...................... 107
Time-Delay Circuit for Remote Control 43
Time-Delay Relay.......................... 66
Tone Control Using Negative Feed-Back........ 23
Tone Modulator for V.H.F. Transmitter........ 86
Tool, Filter Discharging, for Safety........... 58
Transceiver, 112-Mc., Battery-Powered......... 85
Transceiver, Substitute for Transformer in...... 88
Transformer, Combination, for Plate Voltage Control.................................. 59
Transformer, Filament, 6.3 v. from 5-v. Winding.. 53
Transformer Voltage, Boosting of............. 53
Transformer Windings, to Provide 6.3 v. 55
Transformers, Dissimilar, Connecting in Series... 53
Transmitters:
  Band-Change Switch, Simple.............. 36
  Breakdown (Voltage) in 6L6 Oscillators..... 35
  Capacity Ranges, for Different Bands...... 30
  Chassis Connection, Plug-In.............. 38
  Clips, Coil, Non Short-Circuiting.......... 34

PAGE
Coil Clips, Non Short-Circuiting 34
Coil, Three-Band 30
Condenser, Neutralizing, Homemade 35
Control for High-Power Rigs 43
Crystal Frequency, Method of Lowering 36
Crystal Holder, Compact Multiple 37
Crystal Holder, Variable-Frequency 44
Crystal Selector Switch, Inexpensive 37
E.C.O. Coupling Circuit 28
E.C.O. Drift, Notes On 28
Flanges, Support, for Standard Racks 35
Hum, Filament, Curing 33
Interference, Broadcast, Simple Cure for 31–32
Meters, Illumination for 42
Meter-Switching with Toggle Switches 41
Microphone Current, in Portable Rig 33
Neutralizing Capacity, How to Obtain More 31
Neutralizing Indicator, Receiver Used as 42
Neutralizing Indicator, Voltmeter Used as 38
Neutralizing R.F. Stages with Mod. Monitor 30
Neutralizing, Safety Devices for 30–40
Noise from Transmitter, Elimination of 32
Oscillator, 6E5 Tube as Meter Substitute 27
Oscillator, Composite 26
Oscillator, for Fund. and Harm. Operation 29
Oscillator, Harmonic, Circuit of 26
Oscillator, Variable-Frequency Crystal 28
Overload Protection, Automatic for 807 Tubes 42
Parallel Feed in Grid and Plate Circuits 31
Pierce Crystal Oscillator, Getting Results with 25–29
Relay, Non-Chattering Overload with Reset 41
Remote Control with Time-Delay Circuit 43
Single-Switch Send-Receive Control 44
Stand-Off Insulator Substitute and Repairs 36
Socket, Crystal, Three-Way 38
Sure-Fire Interlock 40
Switch, Band-Change, Simple 36
Switching On and Off from Four Locations 40
Subharmonics, from Class-C Amplifiers 31
Trimmer Condensers, Mounting 35
Transmitter and Receiver, "Light-Beam" 122
Transmitter, Clothes Closet Used to House 116
Transmitter Construction, Unusual Ideas in 115
Transmitter, Control Using Single-Switch System 44
Transmitter, Portable, a Modulator for 48
Transmitter, Portable, Microphone Current for 33
Transmitter Power Supply Control Unit 56
Transmitter-Receiver for 112-Mc. Band 89
Transmitters, Control for High-Power Rigs 56
Trimmer Condensers, Mounting of 35
Tube, 83 Rectifier, Replaced by 866 jr.s for H.V. 59
Tube Protective Circuit, Power 62
Tubes, Battery, Automatic Bias for 23
Tubes, Loktal, Removal of Bases 87
Tubes, V-R, Used for Improving Regulation 52

U.H.F. and V.H.F. Converter Using Crystal Det. 86

Variable Frequency Crystal Holder 44
Variable Frequency Crystal Oscillator 28
V.H.F.:
Antenna Array, Mounting for 95
Antenna Array, Six-Element Vertical 90
Antenna, Coaxial Dipole, Feeding with Open Wires 92
Antenna, Concentric, Shatter-Proof Insulators 94
Antenna, Folding Car-Roof 90
Antenna Mounting, Universal Angle 93
Antenna, Rotary Collapsible 94
Antennas, Investigating Performance of 95
Antennas, Mobile, Shunt-Fed 91
Antennas, Three-Element Directional for Portable Work 92
Converter, Using Crystal Detector 86
Field Strength Meter 96
Loktal Tubes, Removing Bases from 87
Noise-Limiter for Mobile Receiver 87
Speech Amplifier or Audio Oscillator 88
Tank Circuit from Coil Shield 87
Tone Modulation for Transmitter 86
Transceiver, 112-Mc. Battery-Powered 85
Transceiver Transformer, Substitute for 88
Transmitter-Receiver for 112 Mc. 89
V.H.F. and U.H.F. Converter, Crystal Detector 86
V.H.F. Antenna, Car-Roof Type 90
V.H.F. Antenna, Investigation of Performance 95
V.H.F. Antenna Mounting with Universal Angle 93
V.H.F. Antenna, Shunt-Fed Mobile 91
V.H.F. Array, Vertical, Six-Element for 113 Mc. 90
V.H.F. Field-Strength Meter 96
V.H.F. Receiver Noise-Limiter 87
V.H.F. Speech Amplifier or Audio Oscillator 88
V.H.F. Tank Circuit 87
V.H.F. Transmitter-Receiver for 112-Mc. Band 89
Voice-Controlled Transmitter Switching 48
Voltage Control, with Combination Transformer 59
Voltage, Line, Simple Control for 66
Voltage Regulation, Improved, for Oscillators 62
Voltage Regulation, Improved with V-R Tubes 52
Voltage, Transformer, Boosting of 53
Voltages, Higher, With 866 jr.s Instead of 83s 59
Volume Controls, Ganging of 24
V-O-M, Multirange 104

Wavemeter, Simple (Band Checker) 107
Workshop:
Circle Cutter, Homemade 10
Drilling Glass, Porcelain and Pyrex 11
Drilling Hints 9
Drilling Tubing and Rods 10
Drills, Starting Tool for 11
Holder, Magnetic for Nuts and Lock Washers 9
Shim Brass to Spring Brass 12
Socket Holes, Repunching With Accuracy 10
Solder, Roll-Form, for Convenience 7
Soldering-Iron Protective Warning 7
Soldering-Iron Rest 7–9
Soldering-Iron Rest and Heat Control 7
Soldering Irons, 6-Volt 8
Soldering Polystyrene Sockets 12
Soldering Tip for Tight Places 9
Soldering Torch, Gas 8
Soldering Torch, Improvised 7
Spraying Paint with a Flit Gun 11
Square Holes, Cutting of 9
Templates for Meter and Socket Holes 10
Winding Coils on Small Polystyrene Forms 12
Winding Small Self-Supporting Coils 12
Workbench, a Third Hand for the 11
Workbench, Light for 12

"Zero Bias" Modulators, Bias Supply for 62